Drawn by T. M. Richardson Jun.r Engraved by T. E. Nicholson.

SHOOTING WILD CATTLE IN CHILLINGHAM PARK.

THE

SCIENCE OF GUNNERY,

AS APPLIED TO THE

MILITARY AND SPORTING ARMS,

OF

ENGLAND, FRANCE, BELGIUM, AUSTRIA, PRUSSIA, RUSSIA AND AMERICA.

By William Greener, Asso. Inst. C.E.

AUTHOR OF "THE GUN", &c &c.

LONDON;

E. CHURTON, 26, HOLLES STREET

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PREFACE

TO THE FIRST EDITION.

The many curious and interesting experiments the Author of these pages has at various times instituted, in every department connected with gunnery, have not failed to point out and expose to him facts and peculiarities, which could never have been discovered in any other way; and rude and limited as such experiments may have been, they nevertheless allow of the most correct deductions being drawn from them.

There exists in this work no fine drawn mathematical calculations, which benefit only the learned. The explanations on the subject of projectile force, are plain, even to plainness. They exhibit no pretence, and with no pretence was the work originated; a desire, a hope, to be of service to his country, induced the Author to attempt the task of

condensing—with an avoidance of all extraneous matter,—as many interesting facts, as in the course of experiment manifested themselves, and bringing them before his readers in plain and simple language.

The sportsman will find in this volume much information, relating to the peculiar property of gunpowder, from which may be deduced the causes of numerous intricate circumstances, which frequently occur and are generally totally unaccounted for; they will also enable him to exercise his own judgment about matters, on which it has been customary for him to take the opinions of others. To the soldier too, the knowledge of the nature of gunpowder is of the first importance, and it is highly essential, that a proper estimate should in all cases be formed, on this most important and vital matter.

Artillery has long been to statesmen the great arbiter. A humble attempt to point out the peculiarities, and improve, by drawing attention to the principles involved in connection with this powerful settler of disputes, cannot be deemed of little moment when the immense warlike preparations of all the nations of Europe are considered.

The remarks under this head will be found not irrelevant.

The manufacture of the great staple of the world, iron, occupies a few pages, and if the result of theory and practice combined can claim attention, the Author trusts his deductions will not be found valueless.

Gun-making should be to the sportsman a matter of peculiar interest. The experience of twenty-three years, and that with devoted attention to all its details, will probably entitle the description to some little authority.

The safety of the user of guns has been especially looked to, and if the earnest way in which defects are condemned, and fraud exposed, be harsh, the author trusts his remarks are no harsher than the occasion demands; ardent in temperament, all deception will ever meet an uncompromising enemy in him.

The proof of gun-barrels is, in this country, a monopoly, and as such, has failed to answer the ends intended, being ineffective and dangerous if relied on, the interest of the user not receiving the attention required. In the exposure of this in-

efficiency, the welfare of the sporting world in particular has induced the laying bare the wound, that a proper remedy may be applied.

The sportsman's science of gunnery, commands on the following pages, the greatest attention, and while unnecessary detail has been strictly avoided, whatever is for the sportsman's interest, has been fully developed.

The rifleman, and the lover of his country, will find much attention and consideration given to points which have, as yet, never been touched upon.

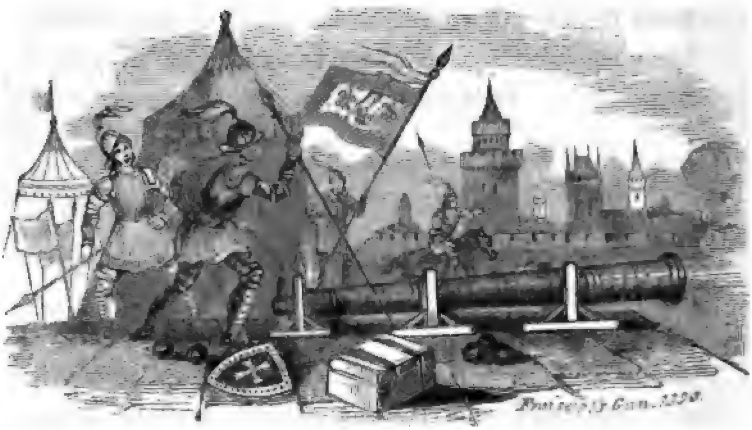
For the style, there is no elegance of diction to be expected, and the author craves the indulgence of the reader. If the subject can be comprehended, through the plain language employed, all is accomplished that he ever hoped for or desired. The correctness of his data is all he professes or wishes to advance as correct.

PREFACE

TO THE SECOND EDITION.

In presenting a second Edition of this work to the Public, the Author begs to express his grateful acknowledgement to the press, and to the public, for the flattering reception with which the first edition was received.

Many corrections and additions have been made in the present volume, and it is hoped and believed it will be found to contain everything interesting and necessary to be known in relation to the Science of Gunnery.



CHAPTER I.

ANCIENT ARMS.

From the earliest ages of the world, the jealousies and bickerings of mankind have been fruitful causes of war. Sometimes, perhaps, justified by political reasons, at others, it may be, arising solely from a desire, on the part of ambitious chiefs, to extend their territories by multiplying their conquests, while, in too many cases, the struggle for religious ascendency has led to the most sanguinary and cruel battles.

War has been considered as a science from the most remote ages, and the ingenuity of the talented has successively been taxed to render it as perfect as possible. It is true,—

> "Man's earliest arms were fingers, teeth, and nails,
> And stones, and fragments from the branching woods,"

but these soon gave place to others, more calculated to decide unequal, and, often protracted, conflicts.

Arms, in a general sense, include all kinds of weapons, both offensive and defensive; and amongst the earliest may be classed the bow and arrow, as it gave facilities to man to capture the wild animals for food, probably before their use was required for the purposes of war. The bow and the sling were the first means invented, and next only to the human arm for projecting bodies with an offensive aim, the great principle which, to the present day, reigns unrivalled, developing the ruling passion of human nature to injure, and remain itself in comparative safety,—"self-preservation" having ever been deemed "the first law of nature."

To the bow and sling were soon added spears, swords, axes, and javelins, all of which appear to have been used by the Jews. David destroyed Goliath with a stone from the brook. The invention is attributed, by ancient writers, to the Phœnicians, or the inhabitants of the Balearic Islands; and the

great fame these islanders obtained, arose from their assiduity, not allowing their children any food until they struck it from the top of a pole with a stone from a sling. And, from the accounts left us—probably fabulous, it appears that the immense force with which a stone could be projected, can only be exceeded by modern gunnery. Even at that early age, leaden balls were in use as projectiles, though we cannot put much faith in Seneca's account of the velocity being so great as frequently to melt the lead. The use of the sling continued over a long period of time, even as late as the Huguenot war in 1572.

The bow is of equal, if not greater, antiquity. The first account we find of it is in Genesis, 21st chapter and 20th verse, where the Lawgiver, speaking of Ishmael, says, "And God was with the lad, and he grew and dwelt in the wilderness, and became an archer." The arms of the ancient Greeks and Persians were such as we have described, with the addition of chariots armed with scythes, in which the chiefs sometimes fought, though their main dependence was upon their heavy-armed infantry. Elephants were afterwards used as adjuncts in their military operations, but their use does not appear to have been very great or very permanent.

The Romans were equipped much in the same manner as the Greeks, with a slight difference in the form of their weapons; and the early Saxons

were similar; those of the Normans were only altered in their construction, except that to them appears to be awarded the invention of the *cross-bow*, an instrument which afterwards became of great repute in England and elsewhere. It has also been asserted, that they were the first to introduce a species of field artillery, from which stones and darts were thrown, and arrows, headed with combustible matter, for firing towns and shipping.

The artillery-proper of the ancients, as the engines for projecting masses of stone and such like materials may be termed, reached to wonderful perfection; and the velocity with which missiles of every description could be thrown from them, attest the skill and ingenuity exercised in their construction; and it is quite evident they are only excelled by the *more portable*, and simply constructed, artillery of our own day.

The great artillerist of the Sicilians, Archimedes, seems to have made some of the most powerful engines, but he, considering any attention to mechanics as beneath the philosopher, has not left us an account of any one of them.

It is said of the cross-bow, that a *quarrel* could be projected from them 200 yards, so that we may imagine the force with which one of these lumps of iron would strike even the strongest armour,—as the velocity, to range that distance, would not be far short of 900 or 1000 feet per second, nearly

equal to the effect of a ball from one of our imperfectly constructed muskets.

We are told incredible stories of the abilities of some of our by-gone archers; should it be true, as stated, that an arrow could be shot near 700 yards, we can easily conceive the immense velocity with which it must have left the bow, as this is quite equal, if not superior, to the range of the best rifles. Though we must bear in mind, that the peculiar shape of the arrow, fits it to cut the atmosphere with less resistance than the sphere of a bullet, and hence one reason of obtaining a more extensive range. There is a story told of the famous Robin Hood, and Little John, "who could shoot an arrow a measured mile." We suppose the mile was the reverse of an Irish one, or they had the advantage of a precious stiff gale of wind. Historians sometimes "draw the long-bow" as well as archers. Much has descended to us of the power of the battering rams of old; but as we have a much more ready method of blowing open gates, by a simple bag of gunpowder, and in a 24 lb. shot, all the force that could be given, even to that one of Vespasian's rams, "the length whereof was only fifty cubits, which came not up to the size of many of the Grecian rams, had a head as thick as ten men, and twenty-five horns, each of which was as thick as one man, and placed a cubit distance from the rest; the weight, as was customary, rested on the hinder

part, and was no less than 1,500 talents; when it was removed, without being taken to pieces, 150 yoke of oxen, or 300 pairs of horses and mules, laboured in drawing it, and 1,500 men employed their utmost strength in forcing it against the walls." With these remarks we shall proceed to introduce the invention of gunnery.

Barbour, in his life of Bruce, informs us that guns were first employed by the English at the battle of Werewater, which was fought in 1327, about forty years after the death of Friar Bacon, and there is no doubt that four guns were used at the battle of Cressy, fought in 1346, when they were supposed to have been quite unknown to the French, and tended to obtain for British arms the victory. Froisart gives an excellent representation of a cannon and cannoneers, in 1390, a cut of which heads this chapter.

The use of guns in warfare is, therefore, comparatively of modern date, and the early specimens which are still extant, or of which we have drawings and descriptions, must have been of very little service, compared with those of the present day. The English musqueteer was formerly a most encumbered soldier. "He had, besides the unwieldy weapon itself, his coarse powder for loading in a flask, his fine powder for priming in a touch-box, his bullets in a leathern bag, with strings to draw to get at them, whilst in his hand were his musket-rest and

his burning match ; and when he had discharged his piece, he had to draw his sword, in order to defend himself. Hence, it became a question, and was so for a long time, whether the bow did not deserve a preference over the musket."*

The mention of the *long-bow* is frequent in English history, and its use contributed, in no mean degree, to many important victories. Perhaps it might be that our forefathers were more skilful in the use of their weapons than their adversaries.

In our wars in France, in the reign of Edward III., thousands suffered by the English archery; and the brilliant success which attended them was, at that time, attributed to their "superior skill, combined with the valour of the Black Prince." So highly was this practice esteemed, that many statutes were enacted in successive reigns to encourage or enforce it.

Archery furnished matter for oratorical display, both in the senate and the pulpit; the palace and the cottage alike bore testimony to the great importance which was attached to the art; and it was at once the study and pastime of the whole nation. Thus, long after the introduction of fire-arms, the long-bow was held in great esteem, and it is no wonder that this favourite instrument should be reluctantly relinquished, after obtaining such universal popularity, and becoming so intimately connected with many

* Grose's Military Antiquities.

national and important events. It is now superseded by the gun, a more potent and destructive engine. The bow, so much valued, has vanished from our ranks by slow gradations, to make way for the musket; and the quivers of cloth-yard shafts have been supplanted by bristling bayonets. These things are now practically unknown as military weapons, though they contended for superiority with fire-arms during two centuries. At this period, and for a long time previously, more attention was paid to the fabrication of defensive armour, than the invention of weapons of an offensive character; hence the perfection that was attained in the manufacture of mail, of every variety, during the fourteenth and fifteenth centuries. The splendid manner in which some of the chivalrous knights of that age chose to have their armour constructed and ornamented, sometimes proved fatal to themselves. Froisart relates, that Raymond, nephew to Pope Clement, was taken prisoner, and put to death by his captors, in order that they might become possessed of his magnificent armour. Those gorgeous and costly fabrications, were likewise doomed to give place to the advancing knowledge and skill of succeeding generations, and are now only known as matters of history, and regarded as valuable curiosities. So late, however, as the latter part of the sixteenth century, armour formed part of the military equipment, and the French cavalry, called *carabins*, are

described as having the cuirass sloped off the right shoulder, that they might the more readily couch their cheeks to take aim, while their bridle arms were protected by an elbow gauntlet.

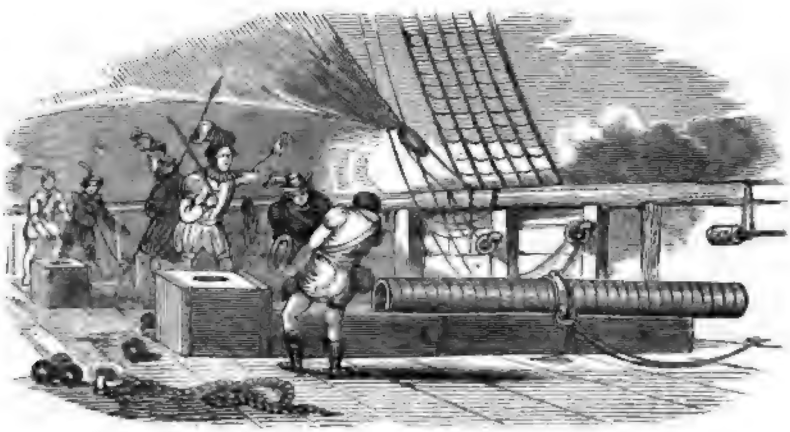
The invention of portable fire-arms is awarded to the Italians by Sir Samuel Meyrick, for, in a memoir in the Archæologia of the Society of Antiquaries, he has named the year 1430 as the precise period of their introduction.

We have already stated that cannon, or heavy ordnance, was in use in the English army in 1327, more than a century before that time. It is not improbable, however, that the Italians were the originators of small fire-arms, for they had for many years been celebrated as skilful in the art of making armour, Milanese armour being considered the most valuable, and it is no wonder that their attention should be directed to the construction of articles of a different description. The invention, in its primitive state, was one of extreme simplicity, consisting merely of a tube fixed to a straight stock of wood, about three feet in length, furnished with trunnions, cascable, and touch hole; in the first instance, at the top, like a large cannon, but afterwards altered to the side, where a small pan was placed to hold the priming, and lessen the liability of its being blown away by the wind. This plan was the first step to the gun-lock.

Before the adoption of the match-lock by the

English, cannon, as we have before shown, had been in use, though they were of a clumsy description.

To the indefatigable exertions of Mr. Dean, we are indebted for the recovery of several brass and iron guns, belonging to the "Mary Rose,"—a vessel of war, wrecked in the reign of Henry VIII. of England, and Francis I. of France, in 1545,—"who while standing along the coast, during a distant firing from the French fleet, under Admiral Annebout, was overpowered by the weight of her ordnance, and sunk, together with her commander and crew of 600 men." One of these iron guns is in an excellent state of preservation, considering it to have been immersed nearly 300 years. The cut below will convey, together with the following description, a faint idea of its unwieldy inefficient construction. It is composed of a tube of iron, whose joint or overlap is as its length ; upon this is a suc-



cession of iron hoops, composed of iron three inches square, being in fact immense rings; these appear to have been driven on while red hot, and thus, by their contraction, forming a much stronger gun when combined with the interior tube, than the generality of accounts given of ancient guns would lead us to expect. Also, it will be perceived, that "composed of iron bars hooped together," is not here correct. We may also mention, that if parties describing guns of this anterior manufacture, will observe strictly, they will find that this is the general method by which they have been fabricated. They all appear to have been loaded by removing a breach part, or chamber, inserting the charge, replacing it, and securing by wedging it behind, as will be seen by a close inspection. Any means of raising or depressing the muzzle does not appear. The barrel, or gun, being sunk in a large block of timber, and secured there by bolts, as a musket barrel is secured in its stock, while a large piece of iron, or wood, was inserted perpendicularly into the deck to prevent the recoil. The advantage of chambers was perfectly understood even at this early period, they were apparently slightly conical, with a spherical bottom. It is no mean evidence of ancient skill, and knowledge of gunnery and mechanics combined, to state, that only a few years ago, a gunmaker, of some celebrity, constructed a number of rifles and pistols to load at the breech, on the very

same principle adopted in this gun 296 years ago. Strange, evidence from "*the vasty deep*" to show "there is nothing new under the sun."

During the sixteenth century, fire-arms of every description then in use, underwent a variety of alterations and improvements, each change bringing with it a change of name, which would neither be profitable or interesting to enumerate here; our object being to trace out the advances which have been made in the manufacture of fire-arms since their general adoption as weapons of war, or auxiliaries to the sports of the field. When first introduced into England, the hand-gun, as it was termed, had already received a slight improvement, in having a covering for the pan, which contained the priming, and a sight on the breech, to assist in giving greater certainty to the aim; it remained thus until the trigger of the cross-bow suggested a contrivance to convey, with equal certainty and greater rapidity, the burning match to the pan.

The difficulty of using an instrument thus objectionably constructed, was, in some degree obviated by the Germans, who, together with the Italians, were at this early period, the principal manufacturers; this was effected to a certain degree, by giving the stocks a crooked form, so that the breech could, with more ease, be brought to the level of the eye; this was, however, only an alteration of form, without involving any principle or leading feature of

mechanical invention. Succeeding the match-lock, in the progress of improvement, came the pyrites wheel-lock, an invention then looked upon as exceedingly curious and ingenious; this also is ascribed to the Italians, and one of the first occasions of its being used, is said to have been when Pope Leo X. and the Emperor Charles V. confederated against France. Whether they are fairly entitled to the merit of this invention is, however, matter of doubt, as it is well known wheel-locks were for a long period manufactured in Germany.

The *snaphaunce*, or fire-lock, is distinctly stated by Grose to be of Dutch origin,—hence the name,—and introduced into England in the reign of Charles II., though their general adoption is stated not to have taken place until the reign of William III., about 1692. Since that period, until the present, their use has been general in all the armies of Europe. How strange it seems that the Chinese should have the match-lock only, to the present day, while there can be no question they had gunpowder some centuries before its introduction into our portion of the habitable globe.

The Syrians were formerly celebrated for their skill in the working of iron. Damascus barrels were not to be obtained, at certain periods, at a price less than their weight in silver. The elaborate mixtures in their barrels, swords, and other weapons, entitle them truly to the honour of being the best of iron-

workers, as we shall hereafter have occasion to show, and the splendour displayed in their inlaying attest their ability. But as mechanicians, formers of complex machinery, they never reached mediocrity. Turkey and Greece, as well as other countries which were renowned as having been, in days of yore, nurseries of the arts, but which have, in later times, degenerated into a condition little better than semi-barbarous, were remarkable for the great labour and pains which they bestowed upon the exterior ornaments of their fire-arms; but they never succeeded in improving the machinery of the lock in the slightest degree.

Although it was not until the latter part of the seventeenth, or the beginning of the eighteenth century, that gun manufactories were established in this kingdom, yet we have attained to a degree of perfection and excellence, unequalled by any other nation of the world. Birmingham is the emporium of the world for guns, from the most inferior, the "*park paling*" so called, of the slave-trade, with which ships might yet be freighted at the cost of seven shillings and sixpence each, up to the elaborately-finished gun of the peer. Most of the alterations which have been made in gun-locks in England have been with a view to simplify the machinery, and obtain the greatest quickness in firing; much complication has been discarded; a thorough conviction having seated itself in the minds of English-

men, that to be perfect, simplicity must be combined. Many splendid emanations of genius are left to us in complex movements of gunnery. The most perfect we have ever seen, is a pistol made in Spain about the end of the seventeenth century. By moving a lever, while the muzzle is depressed, towards the but-end, the lock is primed, half-cocked, and the hammer shut down; return the lever, the powder is in the breech, and the ball before it. We have seen it fire twenty-six shots without a failure, and with one supply of ammunition. The magazine was in two tubes in the stock, and the chance of blowing up was remote. In short, it would be strictly advantageous to inventors in gunnery, to be sure there has been no previous invention combining their principle, as well as their arrangements. We know three puffing inventors at this moment, who are foisting upon the public as their own inventions, plans that are, and can easily be proved to be, but *copies*.

The mine of complex invention was exhausted during the last century, and the greatest benefactor to his species now will be he, who, blowing away the cobwebs of mystery, renders the science as bright as the silvered glass. Nothing now remains of the beautiful machinery of the flint lock; the fancy cock and hammers have given place to a dolphin-headed hammer, striking on a copper thimble, covering a steel pivot. What would the old

lock-filers say to this, could they return and see their handy-work consigned to the scrap-box as old iron? To quote Colonel Hawker, " When flint guns were the order of the day, few sporting gentlemen of distinction ever thought of using anything but the gun of a first-rate maker, for the simple reason that, on the *goodness of the work* depended the *quickness in firing*, and consequently the *filling the bag*. But *now-a-days* every common fellow in a market town, can detonate an old musket, and make it shoot as quick as can be wished." So much for science, Colonel ; and as we have commenced, we cannot retreat, it is against a Briton's creed. Percussion is, or soon will be, general throughout the whole armies of Europe. It is true, the system has its complexities and defects, and it shall be our task to simplify and remedy them, hoping, as we proceed to merit for this work, the title chosen, "The Science of Gunnery."

CHAPTER II.

ON GUNPOWDER.

GUNPOWDER being the base on which the superstructure of this work is to be built, the history, the use, and the principle, are here placed in the foreground, as it is essential to the correct conception of the various matters hereafter to be explained, that the reader be first acquainted with the one grand principle in projectiles, the propellant.

Gunpowder, whether considered relatively to the engines of war, or to those engines used with so much success in the sporting field, has, since its first *introduction*, been a source of much and fre-

quent discussion. In regard to its origin, we shall not much enlarge, nor repeat the many suppositions and conjectures promulgated by the searchers after antiquarian evidence.

The inhabitants of India were unquestionably acquainted with its composition at an early date; Alexander is supposed to have avoided attacking the Oxydracea, a people dwelling between the Hyphasis and Ganges, from a report of their being possessed of supernatural means of defence; it is said, "For they come not out to fight those who attack them, but those holy men, beloved by the gods, overthrow their enemies with tempests and thunderbolts shot from their walls;" and, that when the Egyptian Hercules and Bacchus overran India, they attacked these people, "but were repulsed with storms of thunderbolts and lightning hurled from above."

This is, no doubt, evidence of gunpowder, but as it is unprofitable to follow this further, we shall merely confine ourselves to the European authorities. Many ascribe the discovery to Roger Bacon, the monk, who was born at Ilchester, in Somersetshire, in the year 1214; it is also said that he died in 1285. No doubt he was by far the most illustrious, the best informed, and the most philosophical of all the alchemists. In the 6th chapter of his Epistles of the Secrets of Arts, the following passage occurs,—"For sounds like thunder,

and flashes like lightning, may be made in the air, and they may be rendered even more horrible than those of nature herself. A small quantity of matter, properly manufactured, and not larger than the human thumb, may be made to produce a horrible noise, and this may be done many ways, by which a *city* or an *army* may be destroyed, as was the case when Gideon and his men broke their *pitchers* and exhibited their lamps, fire issuing out of them with great force and noise, destroying an infinite number of the army of the *Midianites.*" And, in the 11th chapter of the same epistle, occurs the following passage—"Mix together saltpetre with *luru mone cap ubre*, and sulphur, and you will make thunder and lightning, if you know the method of mixing them." Here all the ingredients of gunpowder are mentioned, except charcoal, which is doubtless concealed under the barbarous terms used. Indeed, the *anagram* is easily converted into *carbonum pulvere*, with a little attention.

This discovery has also been attributed to Schwartz, a German monk, and the date of 1320 annexed to it, a date posterior to that which may be justly claimed for Friar Bacon; and as accident is stated to have been the means by which he discovered it, we have taken that incident as the illustration at this head of this chapter.

Mr. Hallam refers to the authority of an Arabic author, and infers that there is no question that the

knowledge of gunpowder was introduced into Europe through the means of the Saracens, before the middle of the 13th century; and no doubt its use then was more for fireworks, than as an artillerist projectile force. There is good evidence, too, that the use of gunpowder was introduced into Spain by the Moors, at least as early as the year 1343. Now, as Roger Bacon is known to have been an Arabic scholar, it is not at all unlikely that he might have become acquainted with the mode of making the composition, and also with its most remarkable properties, by perusing some Arabian writer with whom we are at present unacquainted.

This invention, by which the personal barbarity of war has certainly been diminished, is, when considered as a means of human destruction, by far the most powerful that skill has ever devised, or accident presented; acquiring as experience shows us, a more sanguinary dominion in every succeeding age, and borrowing all the progressive resources of science and civilization for the extermination of mankind, which, says Mr. Hallam, "appals us at the future prospects of the species, and makes us feel, perhaps, more than in any other instance, a difficulty in reconciling the mysterious dispensation with the benevolent order of Providence."

The composition of gunpowder, as regards the proportions of the ingredients, has not undergone

any material alteration, the chemical proportions of the ancients being nearly those of the present day.

Gunpowder is an explosive propellant compound, consisting of saltpetre or nitre, charcoal, and sulphur. The terms, explosive and propellant, are not here used as synonymous—they are not convertible: for a chemical mixture may possess the explosive power in a much higher degree than the propellant; fulminating gold, silver, and mercury, are dreadfully explosive, but they have not the same projectile force, nor can they be used as a substitute for it. Several experiments have been made with compounds of this nature, but the result is the reverse of what might be expected. Nothing can resist the exceeding intensity of the action of fulminating powder; when fired in this way, shot is not projected as by gunpowder, but is split into fragments by the velocity of its explosion, as we shall hereafter have occasion to show. Nitre or saltpetre is strictly the soul of gunpowder. It is a triple compound of oxygen, nitrogen, and potassium.

The chemical action of those elements on each other, and the play of affinities between them at a high temperature, occasion the immense effect produced by gunpowder on the application of fire. By universal suffrage, sulphur is included in the mixture, but it is not absolutely necessary for the pro-

pellant power; for nitre and charcoal only will generate effects similar to the compound with sulphur. Gunpowder made without sulphur has, however, several bad qualities; it is not, on the whole, so powerful, nor so regular in its action; it is also porous and friable, possessing neither firmness nor solidity. It cannot bear the friction of carriage, and in transport crumbles into dust. The use of sulphur, therefore, appears to be not only to complete the mechanical combination of the other ingredients, but being a perfectly combustible substance, it increases the general effect, augments the propellant power, and is thought to render the powder less susceptible of injury from atmospheric influence.

"There is one good reason," says the Edinburgh Encyclopædia, "for the use of sulphur, although it does not contribute to the production of any elastic fluid. The carbonic acid which is generated, would doubtless combine with the potash, if it were not for the presence of the sulphur, and thus so much elastic fluid would be lost. That this is the case, we know to be true, from the fact, that carbonate of potash is always formed when nitre is decomposed by charcoal alone, which I shall almost immediately show." This certainly would be the case, to a certain extent, with gunpowder without sulphur—some carbonate of potash would be formed.

The sulphur, we have no doubt, from experiments we have made on this subject, is, in part, engaged during the explosion of gunpowder in expelling the sixth proportion of oxygen from the potash, so as to combine with the potassium, to form a true sulphuret of that metal. This fact is easily ascertained from the circumstance that no sulphuretted hydrogen can be detected, by the most delicate tests, coming from the residuum left after firing gunpowder, until moisture has gained access to it. The bad smell which arises sometime after the burning of gunpowder, is occasioned by the decomposition of the moisture which the sulphuret of potassium attracts from the atmosphere, giving rise, by this decomposition and liberation, to the fœtid foul gas, called sulphuretted hydrogen, and the production of potassa, or the oxide of potassium.

A commission of French chemists and artillerists, was appointed by the government, in the year 1794, to experiment upon the best proportions and constituents of gunpowder for the use of the French service. The following were the proportions prepared at the Essonne works of five different kinds :—

	Nitre.	Charcoal.	Sulphur.	
1....	76.	14.	10.	Powder of Bâe.
2....	76.	12.	12.	———Grenelle.
3....	76.	15.	9.	———M. Morveau.
4....	77.32	13.44	9.24	——— ditto.
5....	77. 5	15.	7. 5	———M. Keffault.

The first and third, after 200 discharges with the proof mortar, were declared the strongest, and the third proportions were adopted at the recommendation of the commissioners. Some few years elapsed, and the first, owing to its better keeping quality, was substituted, as it contained less charcoal, and a little more sulphur. The French government having always been extremely impressed with the value of durability in gunpowder; they have since returned to their ancient proportions, 75 nitre, 12½ charcoal, 12½ sulphur. The charcoal, the absorbent of moisture, being further reduced, and the sulphur, the preserving ingredient, being increased in the same ratio.

Mr. Napier tried a small quantity made of nitre and charcoal only, and was much surprised to find it project a shot as far as the best powder made in the usual manner. It is found that, in small charges, sulphur is advantageous; but, in charges of several ounces, that the projecting force is as great without as with it. Therefore, under certain circumstances, sulphur may be dispensed with, but to make a good gunpowder, nitre and charcoal are indispensable.

Amongst the brilliant discoveries of modern chemistry may be classed the development of the fact, that a chemical combination, to constitute the same compound, always takes place in definite and unalterable ratios. To select one example out of a multitude—one atom of carbon combining with two

atoms of oxygen, produces the gas; because more would answer no useful end. So, with reference to the sulphur, if it enter into combination only with the potassium—the base of the nitre—(which, it is my opinion, it does,) the sulphur should be in that proportion to form the sulphuret of that metal; and in this case there would be no superfluity, for that would only add to the weight of the charge of powder, and diminish its absolute and effective energy. The view of the case which we have taken supposes only two combinations, viz.—carbon with oxygen, and sulphur with potassium. Should there be a more diversified play of affinities, and the several elements of the powder enter into more complicated action, accurate analysis would conduct us through all difficulties, and point out what the proportions of the ingredients ought to be in order to sustain that action, and to produce a perfect ultimate result.

We thus perceive how analysis bears upon the case. We can see by such reasoning on the subject that, theoretically, there can be but *one set of proportions calculated to produce the best and strongest gunpowder*, and that those proportions must depend upon the established and unerring laws of nature. The proportions, then, for gunpowder, by these considerations, will be those in which the carbon will just consume the oxygen of the nitre, and the sulphur as much as will exactly saturate the potassium. This will be effected by an atom each

of nitre and sulphur, and three atoms of carbon; or nitre 95·5, charcoal 18·8, and of sulphur 11·8.

In the present improved state of chemical science, when the nature of the bodies comprising gunpowder is so well known, as well as the compounds resulting from their action on each other, the proportions we have named may be taken as the best for practice.

The charcoal should, in particular, not be less than the nitre, as the smallest portion less than the whole atom would be the same as to leave out the whole atom, in which case there would be no carbonic oxide formed. If, for example, instead of the proportions of nitre 95·5, charcoal 16·2, sulphur 15, the carbon were 16, then there would be 4·2 of carbon left in the residuum, and no carbonic oxide would be formed, since bodies cannot unite but in definite proportions.

From these considerations we can perceive the reason why a small proportion of carbonic oxide is always formed during the decomposition of nitre by charcoal; for it will be evident, that as the nitric acid contains five atoms of oxygen, four of these must combine with two atoms of carbon to form two atoms of carbonic acid, while the *odd atom of oxygen* is compelled to take another atom to form carbonic oxide. But this is not the case in the combustion of gunpowder, as carbonic acid and nitrogen are the principal gases generated.

These proportions differ from any other formula

yet prescribed, and though different in a great degree from the proportions laid down by various writers on the subject, the reasons which are here given, as has been seen, are such as carry with them a conviction of their truth; for there cannot possibly be any benefit arising from a greater quantity of any of these materials than is absolutely necessary to form the composition in question, and if the smallest quantity be above what is requisite to consume the whole, that, however small it may be, is highly detrimental to the effective energy of the mass. What we may here call clean gunpowder, such as may be used with confidence for repeated discharges of fire-arms of any description, is of the greatest importance; therefore, it does not appear to us, that any given proportions is so likely to accomplish that object as these.

TABLE OF COMPOSITION OF DIFFERENT GUNPOWDERS.

	Nitre.	Charcoal.	Sulphur.
Royal Waltham Abbey.	75.	15.	10.
France, National Mills.	75.	12. 5	12. 5
French Sporting.	78.	12.	10.
French Mining.	65.	15.	20.
U. S. of America.	75.	12. 5	12. 5
Prussia.	75.	13. 5	11. 5
Russia.	73.78	13.59	12.63
Austria (Musket).	72.	17.	16.
Spain.	76.47	10.78	12.75
Sweden.	76.	15.	9.
Switzerland (Round powder)	76.	14.	10.
Chinese.	75.	14. 4	9. 9
Theoretical proportions as above.	75.	13.23	11.77

Important as are the considerations as to the purity of the materials employed in the manufacture of gunpowder, and in their due proportions, the importance of manipulations is still greater; for whatever may be the perfection of the two former, if neglect, inattention, or unskilfulness occur in this branch of the manufacture, there cannot be a doubt but the resulting gunpowder will resolve itself into an article of inferior quality.

A slight account of the manufacture will not be uninteresting. The purification of the nitre is as follows: a quantity is dissolved in pure water, and then boiled for several hours, during which time the scum or refuse is carefully skimmed off, allowed to cool gradually, and then pumped into a filtering trough, passing by wooden cocks into bags of canvass very thick, and thence into the carrying pans, by which it is conveyed to vessels to crystallise, allowing the water a means of exit; a reboiling takes place, and a fresh crystallisation, and so on, if by analysis they find the whole of the common salt is not driven off. It is then melted in a copper, to drive off the water taken up in the crystallisation, but at a temperature not exceeding 500° to 600°, then ladled into copper pans to consolidate, which it does in cakes of from 30 to 40 pounds weight; these are broken with a hammer into pieces, and grossly pulverised beneath a large wheel, taken to a mill, and ground to dust as fine and in the same manner as flour.

The charcoal formerly used was made in the common way, by pits, which must have been seen by almost every one. The method is now to *distil* the wood in cast iron cylinders, extracting the pyroliginous acid, &c., by heating them red hot, and allowing all other volatile matter to evaporate, the charcoal only being retained in the cylinder or retorts; and so arises the name *cylinder gunpowder*. The best charcoal for sporting powders is the black dog wood; government uses willow and alder. Any charcoal does for common powders. Charcoal is ground in the same way as the nitre. Sulphur is purified simply by fusing, and when in that state, skimming off the impurities, cooled and pulverised in the same way as the other two ingredients. The three ingredients, after being carefully weighed in their due proportions, are sifted into a large trough, and well mixed together by the hands. They are then conveyed to the powder mill, which is a large circular trough, having a smooth iron bed; two millstones, secured to a horizontal axis, traverse; each making nine to ten revolutions in a minute. The powder is mixed with a small quantity of water put on the bed of the mill, and there kept liable to the pressure of the stones; and if we calculate the weight of the two millstones at six tons, it follows that in four or five hours' incorporation on this bed, it subjects the ingredients to the action of full 10,000 tons. It is this long-continued grinding, compound-

ing and blending together of the mixture, that renders it alone useful and good. After this intimate mixing, it is conveyed away in the shape of mill-cake, and firmly pressed between plates of copper. Bramah's press has been introduced of late years, we should say with a good deal of improvement to the powder, which will be shown hereafter, and by its means the mass is more compressed and in thinner cakes. It is then broken into small pieces with wooden mallets, and taken to the corning house, where it is granulated,* "by putting it into sieves, the bottoms of which are made of bullocks' hides, prepared like parchment, and perforated with holes about two-tenths of an inch in diameter; from twenty to thirty of these sieves are secured to a large frame, moving on an *excentric* axis, or crank, of six inches throw; two pieces of lignum vitæ, six inches diameter, and two inches or more in thickness, are placed on the broken *press-cakes* in each sieve. The machinery being then put in rapid motion, the discs of lignum vitæ (called balls) pressing upon the powder, and striking against the sides of the sieves, force it through the apertures, in grains of various sizes, on to the floor, from whence it is removed, and again sifted through finer sieves of wire, to separate the dust and classify the grain.

* "Wilkinson's Engines of War,"—whose description of the *manufacture of Gunpowder is the best in print.*

One man works two sieves at a time, by turning a handle and excentric crank, the sieves being fixed to a frame, which is suspended over a bin by four ropes from the ceiling."* We have given, and would request, particular attention to this part of the subject, as it has intimate connection with one particular point hereafter to be enlarged upon.

The grains afterwards undergo a process of *glazing*, by friction against each other, in barrels containing nearly 2C0 lbs., making forty revolutions in a minute, and lasting several hours, according to the fancy of the purchaser. This part of the business we entirely disagree with, as injurious to the quick and *certain ignition*, by the fluid generated from fulminating compounds. Gunpowder is finally dried by an artificial temperature of 140° Fahrenheit, which is suffered gradually to decline. The last process is sifting it clear of dust, and then packing it in canisters or otherwise.

The necessity of the process of granulation results from the impossibility of firing mealed powder sufficiently simultaneously to effect an explosion, and also from a knowledge that gunpowder, in a mass, does not explode. Fire a solid piece of mill-cake, and it does not flash off like unto granulated powder, but burns gradually, though with an ex-

* Government has lately constituted a self acting machine for this purpose, which they fully expect will enable them to dispense with human attendance during this, the most dangerous operation.

treme fury, until the whole is consumed. This arises from its density, the compression in the press; it also teaches us one fact, that to be of the greatest service, the time each grain should occupy in burning should be, as is the size of the gun it is required for; for the fact is clear, that the explosion of a heap of gunpowder is but the rapid combustion of all its parts. This action, as is well known, is so rapid, even in a large quantity of powder, that it appears to be a sudden and simultaneous burst of flame. Though philosophically and truly it is not so. It has also been proved that fine grain is stronger in small quantities, and large grain in masses.

The author of the "Engines of War," page 176, has some remarks on the advantages of dissimilar sizes of grain in powder, he says, "In all experiments with gunpowder, it is essential to proportion the size of the grain to the quantity employed for each charge; for if equal weights of the same powder, differing only in the size of the grain, be tried against each other, on a scale of several pounds, the large grain will almost invariably project a ball farther than the fine, while, on the contrary, in charges of only a few drachms or ounces, the fine grain always beats the large." Perfectly right, but he gives no explanation of this, and, in the same page, the following direct contradiction appears, without his apparent knowledge, "For this reason the grains ought to be much larger for mortars than

those for cannon, having longer bores, as the powder in the former requires to be lighted instantaneously, or a portion of it must be blown out unignited, whereas, in the longer guns, there is sufficient time for the perfect combustion of the whole." The gist of the first paragraph is (as must be well known to any one conversant with gunpowder) that fine grain explodes quicker than large, or is sooner burnt out, and consequently generates more force in the same period of time, but when it comes to large quantities, its very quickness is detrimental to its force, by condensing the air around the exterior of the mass of fluid which thus constrains its bound. In small charges, the proportion of condensation is not so apparent, and hence the reason why greater velocities can be obtained with small arms than with cannon. The contradiction follows in the next paragraph, in saying, "for this reason it ought to be much larger for mortars:" quite the contrary. He admits in the first what he here contradicts; the charges of mortars are, in proportion to those of larger guns, as one-third is to one-eighteenth in the weight of shot to lift; the charge of a twenty-four pounder is eight pounds of powder, the charge of a ten inch mortar never more than seven pounds; the length of one gun rarely twenty-eight inches, the other 108 inches; consequently, as a matter of certainty, the powder should be finer for mortars than for longer guns, as it has less time to

consume; he will scarcely contend a large grain will explode as quickly as if it were divided into four small grains.

The pressure of the mill-cake in manufacture, is so to condense it, that the grain shall burn for a period in proportion to its size.

But, to quote the "British Gunner," which says "Hence, to obtain the greatest range, the chamber should be filled with powder, a tompeon of wood, placed over it, and both tompeon and shell surrounded with sifted earth or sand; that, from the increase of resistance, *the inflammation of the powder* may be more instantaneous and rapid, and the fluid more abundant and elastic." We should not have occupied so much space on this question, but that Mr. Wilkinson announces that he has been officially employed, for the last two years experimenting, at Woolwich; it would therefore be extremely prejudicial to the *service*, and to science generally, to have errors of this kind promulgated from one *in authority*.

There exists a diversity of opinion in regard to the strength or projectile force of gunpowder. Dr. Ure remarks,—"If we enquire how the maximum gaseous volume is to be produced from the chemical reaction of the elements of nitre on charcoal and sulphur, we shall find it to be by the generation of carbonic oxide and sulphurous acid, with the dis-

engagement of nitrogen. This will lead us to the following proportions of these constituents.

	Hydrogen 1	Per Cent.
1 prime equivalent of nitre ..	102	75·00
1 .. .. sulphur ..	16	11·77
3 .. .. charcoal ..	18	13·23
	136	100

The nitre contains five primes of oxygen, of which three combining with the three of charcoal, will furnish three of carbonic oxide gas, while the remaining two will convert the one prime of sulphur into sulphurous acid gas. The single prime of nitrogen is therefore, in this view, disengaged alone.

The gaseous volume, in this supposition, evolved from 136 grains of gunpowder, equivalent in bulk to 75½ grains of water, or to three-tenths of a cubic inch, will be, at the atmospheric temperature, as follows:

	Grains.	Cubic Inches.
Carbonic oxide	42	141·6
Sulphurous acid	32	47.2
Nitrogen	14	47·4
		236·2

being an expansion of one volume into 787·3. But as the temperature of the gases, at the instant of their combustive formation must be incandescent, this volume may be safely estimated at three times

the above amount, or considerably upwards of 2000 times the bulk of the explosive solid."

It is obvious that the more sulphur, the more sulphurous acid will be generated, and the less forcibly explosive will be the gunpowder. This was confirmed by the experiments at Essonne, where the gunpowder that contained twelve of sulphur, twelve of charcoal, in 100 parts, did not throw the proof shell, so far as that which contained only nine of sulphur and fifteen of charcoal. The conservative property is however of so much importance for humid climates and our remote colonies, that it justifies a slight sacrifice of strength.

When in a state of explosion, the volume, Dr. Hutton calculates, is at least increased eight times, and hence its immense power; the pressure exerted, if in a state of confinement, will depend on the dimensions of the vessel containing it; so that it would be no difficult undertaking to obtain any pressure above that of the atmosphere, up, we may fearlessly say, to the enormous amount of 2,500 lbs. per square inch; indeed, during the progress of this work, we shall be able to establish a ratio of velocity, and, of course, pressure of explosive force with small guns, much beyond any calculations yet made.

The same quantity of gunpowder subjected to a variety of experimental tests, differs materially in its results, at the same time it is only by such a

method that we can arrive at the relative strength or power which it possesses. Dr. Hutton, whose authority in all mathematical calculation is very high, and whose opinions and judgment in matters of this nature ought not to be unthinkingly controverted, states 2,000 feet per second (with cannon) as the highest velocity which any projectile had attained, at the time of his writing, which had gunpowder for its propellant power.* Since that time it will be shown that a greater amount of velocity has been obtained; and that in the present advanced state of practical science, at least twenty per cent of projectile force has been gained above what has been laid down as the maximum, just stated.

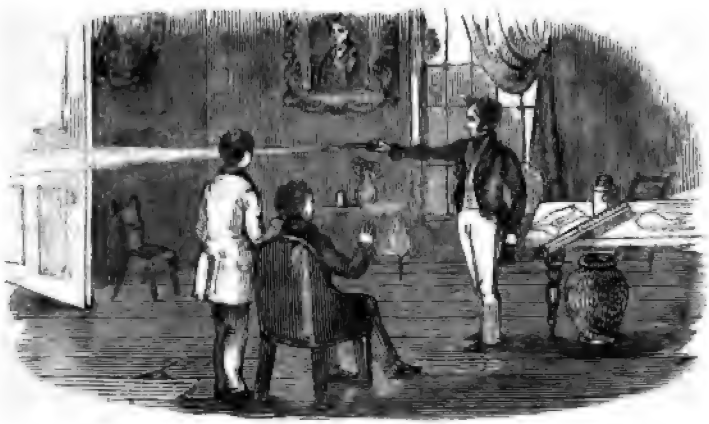
This advantage does not arise, in our opinion, so much from the superior quality of the gunpowder, as from the improvements which have taken place in the manner of applying it. For instance, where experiments are conducted, as was the case with Dr. Hutton, with moveable *eprouvettes*, a certain loss is sustained, in the same degree as the instrument is made to recoil from its original position; therefore, by restraining the recoil, an increase of momentum is given to the projectile, to the same extent as had been exerted upon the *eprouvette*, or cannon, in driving it several feet backward, and instead of dividing the force thus acquired between

* See under Artillery.

the shot and the gun, by having the latter firmly fixed, and the recoil destroyed, the whole power is exerted upon the former, and its velocity accelerated in the same proportion. This principle we have always advocated, and it is so clearly laid down in "THE GUN," published in 1835, that it is to be hoped our government have seen the advantage of it, as certainly a great number of experiments have lately taken place, and a disposition seems to be manifested to turn the knowledge of this fact to some purpose, as we shall show under the head of Artillery.

Gunpowder, though astonishing in its effect, and tremendous in power, may nevertheless be controuled within a limited sphere, and bounds put upon its destructive energy. A singularly curious experiment, first tried at Woolwich on a small scale, we have carried out since to a great extent. Screw into each end of the breach part of a gun barrel a well-fitted plug, drill a communication, and put in a nipple; having filled the barrel with powder, screw in the breach, and fire a cap on it, and the explosive fluid will escape by the small orifice like steam from a pipe. If the barrel be good, it may safely be held in the hand, as represented in the next page, merely using a towel to protect the hand from the heat the barrel imbibes. We have done it repeatedly with no inconvenience, and even carried this experiment much further, firing two ounces of

the best powder in a barrel of good quality, though not in the hand, yet the barrel did not receive any violent emotion, by which it could be inferred that it might not be done with safety.



The duration of this experiment depends upon the description of powder used, for the fine grained powder will burn with greater rapidity than that of a larger and coarser grain, notwithstanding that each is formed of the same ingredients. The finest gunpowder, therefore, is not always the most useful; it is more simultaneously ignited, the particles being smaller, and the interstices more numerous, the fire is more rapidly communicated throughout the mass, and the combined action more intense and vivid, creating an explosion, as nearly instantaneous, as we can well conceive. It ought to be borne in mind, however, that where this description of gunpowder is used as

a projectile force, and a ball or other projectile is propelled through the atmosphere at a velocity above the rate at which sound travels, the elastic force of the atmosphere will offer a greater or less resistance to the projectile, in the same proportion as its momentum exceeds that of sound; hence, as Hutton observes, " only a certain velocity can be obtained," although he has erred in defining it.

We have observed, that, with very short guns, fine gunpowder produces the greatest result, inasmuch as there is no greater column of air in the barrel than the explosive fluid is equal to *displace;* or, in other words, the charge leaving the muzzle of the gun at the very moment when the explosive force is strongest, all the power is thus obtained of which it is capable; but if used in a longer barrel, and the fluid has obtained its greatest power when the charge has twelve inches of the barrel still to travel, the column of compressed air yet remaining in the muzzle of the barrel, exerts a resisting influence, equal to its density upon the charge, and creates a dangerous and unpleasant recoil. If a cartridge be placed in the centre of a barrel eight feet in length, having a bullet at each end large enough to fill the barrel, and a touch-hole drilled to come as near the centre of the cartridge as possible, when it is fired, the balls will certainly be discharged from the barrel, but with a very small degree of force, in fact, merely driven out. With

the same instrument, vary the experiment; place in it a cartridge charged with one ball three feet from the muzzle, leaving a column of air five feet in length, to act against the explosive force of the gunpowder, and the ball will be driven 100 yards with considerable force. Again, if a third cartridge be introduced, similar to the last, two feet from the muzzle, increasing the column of air to six feet, the result, in distance and velocity, will nearly double what has been obtained by the last experiment, tending to prove that air thus forced back upon itself obtains a density, and consequent resisting influence, nearly equal to a well-screwed breech. With the same tube, in order to test this principle further, we put in a double charge of gunpowder, merely backed by a wadding, two feet from the muzzle, and then four balls as tight as possible into the short portion, and the tube was burst in discharging it, immediately in rear of the charge.* In another experiment, we used a common musket barrel, having a plug of iron firmly fixed into the muzzle, the breech being unscrewed, and a ball introduced one-tenth of an inch less in diameter than the bore of the barrel, together with one drachm of gunpowder, we then fired the gunpowder; the explosive matter

* Both this and the following experiment, have been published as tried by other parties, but we are not aware any person had done so previously. Our first experiment took place in 1836.

escaping by the touch-hole. On examination, it was found that the ball was flattened to the extent of one third of its sphere. The charge for the next experiment was increased to two drachms, and the ball in the discharge struck the muzzle very slightly, altering its shape in the least conceivable degree. The charge was next increased to three drachms, and the ball was extracted without any perceptible defect; and, in the fourth trial, another drachm was added, with which the effect was greater than the tube was able to restrain, and it was in consequence burst, about three inches from the muzzle.

From this we infer that, in the first trial, the velocity of the ball was not so great, but that the air escaped past it by what is technically called the windage, allowing it to strike the plug at the end of the barrel, with sufficient force to alter the shape of the lead in the manner described. The second trial gave an increased velocity; the opposing forces being so nearly balanced that the ball scarcely reached the end of the barrel, and was very little injured. In the next trial the velocity became so great, and the air was condensed to such an extent, that the ball struck upon a cushion-like surface so highly elastic that it was extracted without the least injury. The last was too powerful, inasmuch as the lateral pressure of compressed air rent the tube asunder, and found for itself a vent.

The one great cause of this and other barrels

bursting, arises from the velocity becoming too great, and driving back the air upon itself, until the mutual repulsion of the particles form an almost impenetrable barrier, exerting a lateral pressure on the barrel, and resisting the passage of the elastic fluid. To make the explanation plain; supposing that the charge having condensed the air for the distance of three or four inches immediately preceding it, and then came to rest, the waves of vibration, travelling at the rate of 1,300 feet per second, would communicate to the remainder of the column the same pressure, and an equilibrium would take place. But as this is not the case, and the air becoming still more highly compressed by the velocity not decreasing, the lateral pressure becomes greater than the fibres of the iron are able to withstand, and consequently the barrel is burst. Many accidents arise from this cause, solely and without any blame being attached to either maker or user; for while on this subject we may remark that this is the more likely, inasmuch as the powder with which barrels are proved is not the strongest, and also of a large grain, so that it is quite within the range of probability, that a barrel may and does often stand proof, and yet burst when it comes to be used with extreme fine grained strong powder; as it is quite clear a high velocity must create danger.

To pursue the subject still further, in order to

procure conclusive evidence in support of this argument. We had a tube of iron manufactured, sufficiently good in quality to bear an enormous pressure, three feet in length, with a bore large enough to admit an ounce ball, the sides of the arch being full a quarter of an inch in thickness; a piece of steel, one inch in length, was then turned to fit the bore well, but not so tight as to prevent its free action, this we called a piston; from the centre of the tube to the muzzle, was drilled* on all sides a number of small holes, a quarter of an inch distant from each other, in all amounting to sixty-eight; these again were fitted with small pieces of steel wire, hardened, projecting into the interior of the tube a quarter of an inch, so that the piston, in its upward movement, should strike these pins, and thus enable us to judge how far it was driven by each experiment; each one of the tube was then fitted with a breech, firmly screwed in, the upper one having a flat internal surface, the lower one, where ignition was to be communicated (by means of a percussion cap), being a conical or patent breech. This we termed an explosion metre, and truly it answered its purpose. With two drachms of the best canister gunpowder, the piston was propelled nineteen inches along the tube, breaking eight pins. The same quantity of the newly-in-

* A representation of it lies on the table in the last woodcut.

vented diamond grain reached only eighteen inches, or four pins. No. 2 grain, of both Laurence's and Pigou and Wilk's manufacture, reached twenty-four inches, or twenty-eight pins, whilst a very superior powder, furnished us by John Hall and Son, containing in one grain five of diamond, four of canister, and two of the above makers' No. 2, reached twenty-seven inches, and broke forty pins; in each of these experiments the greatest accuracy was observed in preparing the metre as well as in weighing the charge.

These things go far to satisfy us, that in all uses of gunpowder, the grain should be of a size proportioned to the length and bore of the gun, for if we have not an accellerating force to overcome the increasing resistance of the compressed column of air in the barrel, there is great danger that the gun may be burst, and probably be productive of great mischief, whilst a judicious application of the extraordinary power thus placed at our disposal, may be alike conducive to our safety or our pleasure. A musket ball can be driven through an half-inch boiler plate, but it can only be accomplished by using as much powder as will generate a gradual, though rapidly increasing power, until the ball has passed the limits of the tube; more is unnecessary.

Nitre is not the only salt that has been employed in the manufacture of gunpowder. Its quantity or

proportion in mixture has been lessened; and the deficiency supplied by another elementary combination, namely, by the chlorate of potassa.

The French have succeeded in making powder, of which it forms one of the component parts, and they say it ranges the projectile double the distance; this we doubt. The proportions of the mixture are, nitrate of potash twenty-five parts, chlorate of potassa forty-five, sulphur fifteen, charcoal seven and half, and locopodium seven and half parts. In the year 1809, a similar kind of powder was proposed to the English Government, by a person of the name of Parr; but its introduction was very properly opposed by Sir William Congreve, on account of the danger attending its use, and also from a knowledge of the fact, that there was no piece of ordnance in the service able to withstand its effects. The proportions were, chlorate of potash six parts, fine charcoal one part, sulphur one part. These ingredients to be *carefully* mixed together and granulated. The above mixture was not laid aside, only from the want of power to restrain its effects; it is useless, from the very extreme rapidity of its explosion; it forms the atmospheric air into a wall of adamant; by the condensation, confining it to a comparatively small space; it becomes lightning, an electrive fluid, which, from its very intensity, cannot displace any great mass of air. Thus does nature guard herself

from any intrusion, showing vain man her laws are immutable.

Neither can any advantage arise from any greater velocity in projectile force, except we can obtain that by a graduated scale; for masses cannot, from a state of rest, be put in extreme motion in an instant, as it were; but as philosophy teaches us, and experience makes evident, a portion of time must be occupied, short however that may be. All motion is gradual, and cannot be obtained otherwise, than gradually; and hence the fact, that lightning conveyed into a tube filled with projectiles, would not drive them out, would not project them, but the blow would break them in pieces; so is it with this mixture, it is useless from its very rapidity. we have shown that even fine grain gunpowder is too quick, and that its quickness destroys its power; how much more so is the other, and what would it avail us with these disadvantages. Mr. Wilkinson mentions what he conceives to be a curious fact, he says, "If a train of gunpowder be crossed at right angles by a train of fulminating mercury, laid on a sheet of paper on a table, and the gunpowder lighted by a red hot wire, the flame will run on until it meets the cross train of fulminating mercury, when the inflammation of the latter will be so instantaneous as to cut off the connection with the continuous train of gunpowder, and form a T, leaving one half of the powder train unignited;"

and again, "if the fulminating powder be lighted first, it will go straight on, and pass through the train of gunpowder so rapidly as not to inflame it at all." Precisely so, and the cause is quite apparent, its rapidity condenses the air so quickly as both to remove the grains of gunpowder liable to come in contact with the flame, and to form the condensed air into a line of demarcation, as heat cannot be taken up by the air quicker than it will convey sound, and before that can take place the explosion is over. He also states, "I have made many experiments on the subject, and have ascertained that the flame of all fulminating powders will pass through the centre of a box filled with gunpowder, without igniting one grain of it." What nonsense. The same answer applies to this, as the one before; if the box was filled, or nearly so, the flame could not pass through without inflaming it; but if only partially so, that the flame could, by the condensation of air, drive or blow the powder out of its way, the result would be as he describes, but is this a fair experiment? We have no wish to hold Mr. Wilkinson's opinions up to notice, save as far as is necessary to dispel any incongruities which appear in the Elucidations of Science; he states in the same work the following inconceivable jargon. Speaking of the explosion of a shell on board the Medea, "off Alexandria," when unscrewing the fuse, and also of a similar accident on board the Ex-

cellent, at Portsmouth, he says, "Any idea which can throw light upon unaccountable accidents, may even, if incorrect, be useful. I therefore venture to suggest the possibility of the fuse composition becoming altered in its properties, by the action of time and moisture, or by extreme dryness; for it is a fact very little known, that the ordinary ingredients of gunpowder—saltpetre, charcoal, and sulphur, exactly in the same proportions as they are employed in that manufacture, namely—75, 15 and 10 parts of each respectively, can be rendered as highly explosive as fulminating powder, simply by an alteration in the process of granulation and drying, so that gunpowder thus made would not bear the friction of one grain against another, and would explode merely by rolling in a cask; such gunpowder is extremely strong, and Sir William Congreve tried many experiments with it, but it was too dangerous to introduce into the service, and, like many other curious facts, is almost forgotten."

Can it be possible he does not know that the composition he is speaking of, was not made from the same proportions and ingredients, but from the chlorate of potassa, and which we before described. You can, we are aware, explode with extreme percussion a single grain of common gunpowder, but not more; and powder, made from the nitrate of potash, never can be rendered explosive in the way he alludes to.

In all mining operations, in the quarrying of stone, the destruction of sunken rocks, or in any other operations, where it is desirable to detach large masses, the use of gunpowder is indispensable, not only because it decreases manual exertion, but also because it can be used under circumstances and in situations unapproachable by other means. The consideration for the miner, becomes, what is best suited for the purpose; the finest grained powder is useless, as is well known, and is also more expensive, but its principal defect arises from its quickness: another proof, were any wanting, of velocity not being advantageous, if carried beyond the line of demarcation which nature draws. Masses cannot be detached without first putting the whole in motion, and as this cannot be done in a very short time, it is necessary so to prolong the explosion, that the wave of vibration has time to travel throughout the whole of the mass acted upon, and a repetition of these waves is necessary before any mass can move. Now, to obtain this, it is necessary that matter be so incorporated with the powder as to prolong that explosion; bituminous substances might be applied with effect, for their burning would keep up the heat necessary to hold the permanent gasses at their utmost stretch of expansion.

It must be obvious to our readers that from the extremely high character English sporting gunpowder

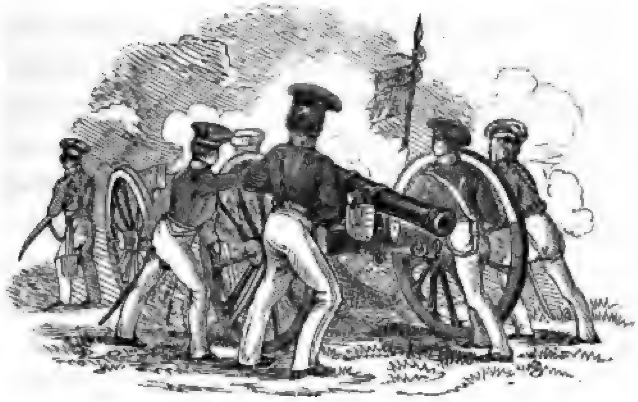
has obtained all over the world, that there must be considerable improvement either in the purification or manipulation of ingredients effected by the private manufacturers; the unwearied care bestowed on this point by several of our best makers is beyond all praise. To explain or enlarge upon this point would be injurious to individual skill and enterprise, and be the means of imparting knowledge to the "drone" who have not ability to advance but gather from the brains of others. This we can fearlessly assert, from very extensive observation and experiment, that no manufacturers of the present day have made greater steps in improvement than the well-known makers, John Hall and Son, of Faversham, their office, 23, Lombard Street, London, the sole manufacturers of the rifle gunpowder, in red japanned canisters, and the long celebrated glass gunpowder in black canisters. Both qualities are of such extreme strength and so comparatively free from unctuous deposit as to fully satisfy us, they stand first on the list. The French set great value on the "Poudre de Chasse of England;" rather singular we should excel those who pride themselves so much on their chemical knowledge; but as before remarked, it is certain that the intimate incorporation of the ingredients is of more value than the chemical proportions.

All military and naval gunpowder is now manufactured of the greatest strength that can be acquired

"*at the government mills*," a sample of which is furnished to each contractor with each contract and to this strength they are limited. We believe Messrs. John Hall and Son have been the most successful manufacturers in complying with the "*extreme*" nice regulations now adopted by the Board of Ordnance as to range, size of grain, (cleanness,) &c., in the powder they have delivered under their different contracts.

Dr. Hutton made all his calculations with the powder under the old regime, consequently there is nothing startling, in finding some part of this article varying considerably from the recognised principles laid down by that high authority. We shall hereafter clearly show that a much greater amount of explosive velocity may be strictly found to exist, than he has given us as the result of his experiments.

As to the application of gunpowder, as a motive power for machinery, we are aware that many eminent men are of opinion that it is incapable of such application, yet we doubt not but its velocity may be so decreased and controuled as to make it available for this purpose.



CHAPTER III.

ARTILLERY.

Artillery, in the general acceptation of the word, includes all and every description of gun of greater power and dimensions than muskets and other shoulder guns. The term, as we have before stated, was, in olden times, applied to all engines used in the projecting of missiles of every description larger than *quarrels* or *arrows*.

Modern civilization, with its giant strides of improvement, has rejected the cumbrous and unsightly complication of springs, levers and wheels and given to us, in their stead, the light and hand some six-pounder, which is so easy of transit that

it can accomplish the most complex and difficult movements, while the horses are at their fullest gallop. A single minute now suffices to stop from the greatest speed, unlimber, load, fire a couple of rounds, remount, and they are immediately at a distant point—while the eye can but follow, and the mind imagine, the destruction that must attend their evolutions, when the " deep-tongued gun" is fired in anger. The comparative effects of guns of various calibre and power will be slightly noticed, and an attempt made to convey to the reader their peculiar defects and advantages. The artillery of England comprises an immense variety of *weapons of war*, suited for various purposes and situations, as experience has dictated, or necessity required. The present state of our artillery requires *an advance to the front*, to be in a line with the march of science, as regards the knowledge of gunpowder and projectiles; we may, therefore, be permitted to animadvert on what appears to us to need improvement.

The profession may think it presumptuous to offer a suggestion or give an opinion; for it too frequently happens, that individuals, who have employed their whole time and study on one especial subject, think they alone can understand it, and consider any opposition to their opinions, or any doubt of the soundness of their conclusions, little short of a positive sin. They forget, however, that

a party engaged in card playing sees not the errors which appear clearly to the observer, and throws away chances which, by his aid and knowledge, they might turn to profit and advantage.

Having given some attention to the subject, we would now offer our *correction*—not from any presumptuous feeling, but because we think the government arrangements of gunnery not so perfect *as they might be.*

The authorities who have controul over the *bull dogs of warfare*, are, we are sorry to state, too remiss, too unwilling, to avail themselves of valuable improvements and discoveries, clinging too much to prejudice. To such an extent is this neglect carried, that many improvements become old and familiar to half the kingdom, aye, and are adopted by other countries, before our guides take advantage of them: for truly with them talent and ingenuity are scantily patronized. Our wish is to aid in sweeping away the cobwebs which still hang on the science of great gunnery; and to push the *spur of conviction deep*, that instead of Britain *copying*, she may, in times of peace, lead the way of improvement, so that when war comes, she may not be unprepared.

We have in this chapter endeavoured to divest the subject of all extraneous matter, and impart as much information as will enable the reader to form an opinion for himself, and understand a portion of a science hitherto considered abstract, and which is,

no doubt, abstruse. This we have sought to effect in language of the plainest description, avoiding strictly, wherever it was possible, all technicalities.

The guns of the British nation may be divided into four classes—the artillery of the Park, besieging guns or battering train, garrison guns, and marine artillery. The number of different descriptions of rates, *or horse-power*, of guns, vary in all the different classes of the service. There are light, medium, and heavy six-pounders; long and short twenty four-pounders; and two or more weights in all the varieties, even up to the ten-inch gun and thirteen inch mortar. We have iron ordnance and brass, for long and short ranges, for small or great velocity. The rate, weight, length, charges, point blank, extreme range, &c., of iron guns, will be found in the annexed table, by which will be seen, at a glance, the various matters referred to.

IRON ORDNANCE.

Nature of Gun.	Weight.	Length.		Charge of Powder.		Point Blank Range.	Extreme at 5 deg.	Windage decreased.
Pounders.	Cwts.	Ft.	In.	Lbs.	Oz.	Yards.		
32	63	9	7	10	10¼	380	1950	
32	56	9	6	10	10¼	380	1950	
32	48	8	0	8	0	330	1740	
32	40	7	6	6	0	340	1700	·06
32	32	6	6	5	0	330	1640	·11
32	25	6	0	4	0	225	1500	·11
32	25	5	4	4	0	225	1500	·11
24	50	9	6	8	0	360	1850	
24	48	9	0	8	0	360	1850	
24	40	7	6	8	0	340	1800	
24	33	6	6	6	0	260	1560	
18	42	9	0	6	0	360	1780	
18	38	8	0	6	0	340	1730	
12	34	9	0	4	0	360	1700	
12	29	7	6	4	0	340	1650	
9	26	7	6	3	0	330	1600	
6	17	6	0	2	0	320	1520	
Carronades.								
68	36	5	4	5	10¼	270	1420	
42	22	4	6	3	8	240	1350	
32	17	4	0	2	10¼	235	1260	
24	13	3	9	2	0	225	1150	
18	10	3	4	1	8	220	1100	
12	6	2	8	1	0	205	1000	

Brass guns are invariably lighter, and considered less likely to burst. Gun metal, technically so called, is a compound of copper and tin, in the proportion of eight and ten pounds of the latter to 100 pounds of the former. The peculiar property of the tin is to give hardness and solidity to the mass. The greater proportions are used principally for mortars, as they require a greater degree of hardness than other guns. A peculiar property attaches to the

using of brass guns. If a considerable quantity of rounds be fired in rapid succession, the bore of the gun becomes to a certain extent elliptical, arising entirely from the extreme windage allowed by the present established rules of British gunnery. This peculiarity is produced by the tendency of the shot at the breech, when put in rapid motion, to strike upwards, and then rebound down, and so on to the muzzle. Iron guns are not liable to this, although the same cause exists, from the unductile nature of the cast iron. Brass guns are, after certain use, re-cast, which is done solid, with the cascable of the gun downwards, to give a greater density to the metal at the breech. The boring and turning are done simultaneously by a very simple arrangement. At the siege of Badajos, the firing continued for 104 hours, and the number of rounds that each gun fired averaged 1,249; and at the siege of Sebastian, the quantity fired by each gun was about 350 rounds, in 15½ hours. These guns being of iron, none of them were rendered unserviceable; though three times the number of brass guns would not have been equal to such long and rapid firing. All brass guns are bouched with a bolt of copper at the vent, on the same principle as flint guns for sporting were formerly with gold or platina; copper withstanding the rapid escape of the flame better than the gun-metal. The charges, ranges, &c., are as follows.

EXTREME AND POINT BLANK RANGE OF BRASS ORDNANCE, CHARGE, &c.

	Charge.	Point Blank Range.	Extreme Range.	Elevation.	
	Lbs. Oz.	Yards.	Yards.	Deg.	
Medium 12-pounder	4 0	300	1200	3	With round solid Shot.
Light 12-pounder..	4 0	200	1000	3	
9-pounder	3 0	300	1200	3	
Long 6-pounder ..	2 0	300	1200	3	
Light 6-pounder ..	2 0	200	1000	3	
Heavy 3-pounder ..	1 0	200	1000	3	
24-pounder Howitzer............	2 8	250	950	3½	With common Shells. When Shot is fired, they increase the elevation ½ a deg.
12-pounder Howitzer............	1 4	200	950	3¾	
Heavy 5½-inch Howitzer	2 0	250	1750	12	
Light 5½-inch Howitzer	2 0	150	1350	2	

The twelve, ten, and eight-inch guns, almost form a class of themselves. They are intended for throwing hollow and solid shot. The larger, are the description of ordnance with which we at present arm our steam frigates. The Gorgon used them at the siege of Acre.

These are unquestionably part of the many doubtful descriptions of artillery which have been adopted of late years, with a view to *fracture* more than to secure a range of projectile. They are enormous machines, as will be seen on reference to their weights; and their splintering powers are certainly very extensive indeed. But their range is contemp-

tibly small, if we take into consideration their great weight. The effect of the explosion of the charge of one of these guns must be sensibly felt even by the strongest built steamer in the world. They are used with traversing beds. The gun carriage, when recoiling, been driven up an inclined railway, with from 3° to 4° of elevation, in a backward direction, from the cascable of the gun.

This greatly tends to lessen the distance the gun would be driven back, and facilitates the running out of the piece to the point of discharge. The wood cut, a few pages farther on, contains a representation of the principle. The following table displays the ranges, &c. of this class.

RANGE AND ELEVATION, &c. OF 12, 10, AND 8-INCH GUNS, AT POINT BLANK AND EXTREME, AND 10, AND 8-INCH HOWITZERS.

Nature of Ordnance.	Length		Weight		Charge powder		Point Blank Range.	Extreme ditto.	Elevation.
	ft.	in.	cwt.	qr.	lbs.	oz.	yards.	yards.	
12-inch Gun, with hollow shot, weight 112 lbs.	8	4	90	3	12	0	240	1550	6 deg.
10-inch, with ditto, weight 86 lbs.	7	6	57	3	7	0	210	1500	6 deg.
Ditto	8	4	62	1	8	0	250	1400	5 deg.
Ditto	9	4	84	0	12	0	325	1700	5 deg.
8-inch Gun, with hollow shot, 48 lbs.	6	8½	50	0	7	0	210	1300	5 deg.
8-inch ditto, solid shot, 68 lbs.	8	6	60	0	9	7	340	1500	5 deg.
Ditto	9	0	65	0	10	0	300	3250*	15 deg.
Ditto, hollow shot	9	0	65	0	12	0	370	2920*	15 deg.
10-inch iron howitzers	5	0	40	0	7	0	2 deg. 600	2078	12 deg.
8-inch ditto	4	0	21	0	4	0	3 deg. 730	1725	12 deg.

* Length of time occupied in flight, 14 seconds, and 15¼ seconds.

Mortars are intended for three purposes. Firstly to bombard a town, or injure the defenders' artillery; secondly, to fire or overthrow the works, and to spread havoc and slaughter among the troops; thirdly, to break through the vaulted roofs of barracks and magazines, which are not bomb-proof, or, in other terms, are not strong enough to resist the fire.

They consist, as will be seen, of five descriptions, but the 10-inch is considered, on the score of economy, as equal to all useful purposes. The French have, at various times, constructed them of enormously large dimensions, but certainly with no useful result. The monster mortar, used at the siege of Antwerp, fired only 10 or 12 shots, and with comparatively little effect; and burst some time after, while under a course of experiment, with a considerably less charge than it had formerly withstood; thus affording one very conclusive and illustrative fact in the theory of vibrations in metals; as there can exist no question, the shell, from the smallness of the charge, was longer detained; the waves of vibration travelling so rapidly through the mass that the metal at last lost its cohesive nature from their very rapid succession.

It will be perceived, on reference to the adjoining tables, that ranges are obtained by the modifications of charges.

* ENGLISH MORTAR PRACTICE.

13-Inch Iron. Weight, 36 cwt. † Shell filled, 200 lbs. Bursting powder, 6lb. 2oz. Blowing ditto, 0 lbs. 2 oz.

Elevation.	Charge.	Fuse.	Range.
deg.	lbs. oz.	inch	yards.
45	2 1⅓	1·9	450
	2 3	2·	500
	2 4¾	2·1	550
	2 6	2·2	600
	2 7¾	2.3	650
	2 9½	2·4	700
	2 11¾	2·45	750
	2 14	2·5	800
	3 0½	2·55	850
	3 3	2·6	900
	3 5½	2·65	950
	3 8	2·7	1000
	3 10	2·75	1050
	3 12	2·8	1100
	3 14	2·85	1150
	4 0	2·9	1200

10-Inch Iron. 16 cwt. 2 qrs. 92 lbs. 2 lbs. 10 oz. 1½ oz.

Elevation.	Charge.	Fuse.	Range.
deg.	lbs. oz.	inch	yards.
45	1 0½	1·9	450
	1 2	2·	500
	1 3¼	2·1	550
	1 4¾	2·2	600
	1 6	2·3	650
	1 7½	2·4	700
	1 9	2·45	750
	1 10	2·5	800
	1 11	2·55	850
	1 12	2·6	900
	1 13	2·65	950
	1 14	2·7	1000
	1 15¼	2·75	1050
	2 0¾	2·8	1100
	2 1¾	2·85	1150
	2 3	2·9	1200

8-Inch Iron. 8 cwt. 1 qr. 46 lbs. 1 lb. 14 oz. 1 oz.

Elevation.	Charge.	Fuse.	Range.
deg.	lbs. oz.	inch	yards.
15	0 14	·8	500
	1 0	1.	550
	1 2	1·1	600
45	9¼	1·9	450
	10¾	2·	500
	12¼	2·1	550
	13¾	2·2	600
	14½	2·3	650
	15½	2·4	700
	1 0	2·45	750
	1 0½	2·5	800
	1 1¼	2·55	850
	1 2	2·6	900
	1 2¾	2·65	950
	1 3½	2·7	1000
	1 4	2·75	1050
	1 4¾	2·8	1100
	1 5¼	2·85	1150
	1 6	2·9	1200

5½-Inch Brass. 1 cwt. 1 qr. 10 lb. 16 lb. 10 oz. ½ oz.

Elevation.	Charge.	Fuse.	Range.
deg.	oz. dr.	inch	yards.
15	6 0	·7	350
	7 0	·75	400
	7 8	·8	450
	8 0	·85	500
25	5 8	1·1	480
45	4 8		300
	4 12		350
	5 0	1·75	400
	5 4	1·8	450
	5 8	1·85	500
	5 12	1·9	550
	6 0	1·95	600

4 2-5th Inch Brass. 3 qrs. 19 lbs. 8 lbs. 5 oz. ½ oz.

Elevation.	Charge.	Fuse.	Range.
deg.	oz. dr.	inch	yards.
15	4 8	·8	450
	4 12	·85	500
25	4 0	1·1	540
45	2 6	1·65	300
	2 9	1.7	350
	2 12	1·75	400
	3 0	1·8	450
	3 4	1·85	500
	3 8	1·9	550
	3 12	1·95	600

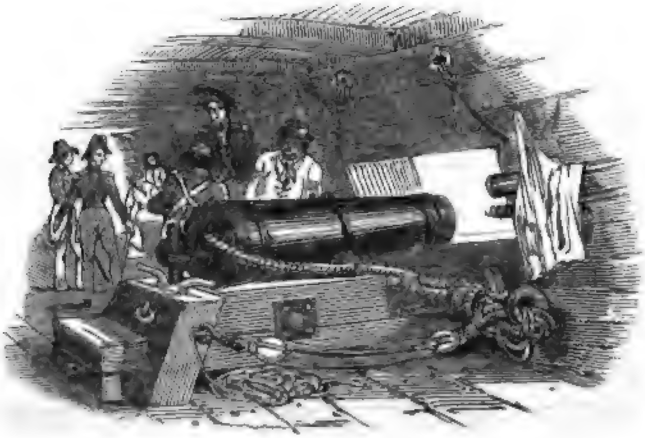
* Artillerist's Manual. † Shells filled with sand, which will account for the weight.

13-INCH LAND SERVICE.	10-INCH DITTO.	8-INCH DITTO.
Greatest charge, 8 pounds powder.	4½ pounds.	1 pound.
Greatest range, 2,706 yards.	2,536 yards.	1,720 yards.

WEIGHT OF LAND AND SEA SERVICE MORTAR.

Inches.							Inches.
13 Land service,	Weight,	36 cwt.	2 qrs.	0 lbs.	Length,	36·563
10 do.	do.	16	2	0	do.	28·125
8 do.	do.	8	2	14	do.	22·5
5½ do. brass	do.	1	1	15	do.	15·104
4⅗ do.	do.	0	3	20	do.	12·713
13-inch sea service	do.	100	1	14	do.	52·81
10-inch do.	do.	52	0	0	do.	45·62

Carronades are a short description of ordnance without trunnions, but fastened by a loop under the reinforce. Their construction is materially different from that of guns. They have a chamber like a mortar, a part scooped out inside the muzzle, forming a cup, and they have also a patch on the reinforce. The name arises from the Carron Foundry in Scotland, the first of them having been cast there in 1779. The construction is considerably lighter than that of guns of similar calibre. Their principal use is on board ship, but they are sometimes used in casemates, or retired flanks of fortresses.



The use of this peculiarly constructed gun will be of short duration, if ever we see another war. Nothing but the bull-dog fighting of the last war could have given them any length of existence at all. When ships are laid alongside of each other, muzzle to muzzle, or within pistol shot, these ordnance are as good as any other. But these scenes will not again take place.

The proportions of all guns to shot, will be found below, and when we look at that, it will scarce be conceivable how so light a gun can project so heavy a shot. But one principal advantage is the very trifling windage with which they are used, the greatest force being gained that the powder is capable of giving, under the circumstances.

COMPARATIVE WEIGHTS OF GUNS AND SHOT.

	Weight of Guns.	Comparative Weight.		Weight of Guns.	Comparative Weight.
	Cwts.			Cwts.	
12-inch Gun..	90	1 to 112	12-pounder ..	34	1 to 318
10 do.	84	1 .. 82	Do.	29	1 ..270
8 do.	65	1 ..107	Do.	21	1 ..196
8 do.	60	1 .. 96	9-pounder ..	31	1 ..285
8 do.	50	1 .. 82	Do.	26	1 ..323
32-pounder ..	64	1 ..224	Do.	17	1 ..211
Do.......	56	1 ..196	6-pounder ..	23	I ..429
Do.......	48	1 ..168	Do.	17	1 ..327
Do.......	40	1 ..140	68-pound Carronades ..	30	1 .. 59
Do.......	32	1 ..112	42 do. do.	22½	1 .. 58
Do.......	25	1 .. 84	32 do. do.	17	1 .. 62
24-pounder ..	50	1 ..233	32 do. do.	25	1 .. 96
Do.......	48	1 ..219	24 do. do.	13	1 .. 55
Do.......	42	1 ..186	18 do. do.	10	1 .. 56
18-pounder ..	42	1 ..261	12 do. do.	6	1 .. 56
Do.......	37½	1 ..233			

The recoil, which in all the beforementioned guns is very great, arises from the blow communicated to the iron in immediate contact with the explosive fluid. The granulatory system of the metal transmits to those grains, or crystals, immediately behind them, the blow or concussion they are subjected to, and these again to others, and so on, until the vibration has passed through the metal from the interior of the breech to the exterior of the gun. And hence arises the advantage of metal. If we double this at the breech, or have eighteen inches of metal instead of nine, the period of time the vibration takes to communicate the greater distance will be doubled, and hence arises the benefit; because the projectile will have left the muzzle of the gun ere the gun moves.

We are satisfied that in all small guns, from their slight substance, recoil is communicated a great deal quicker than in larger ones; and so arises the well-known fact that in shooting you receive a knock nearly simultaneous with the explosion. The greater and heavier the gun,—even carry it up to Gen. Miller's gun of 84 cwt., if the proportion the shot bears to it be not great,—the less will be the velocity of recoil. But in that of carronades, as will be seen, the proportions are as high as 1 to 55, while in long guns, it is 1 to 429, making a considerable degree of difference. This principle must and will be further carried out—it has the true germs of science to aid and advance it.

Our ancestors had far from a contemptible knowledge of projecting bodies by gunpowder. Their explosive fluid was not good, for there is clear proof, even since the time of Robins, that the purification of the ingredients has nearly, if not quite, doubled the explosive force. Their mechanical construction and outer mould of guns, are calculated to resist and limit the effects of recoil to a great extent.

Accumulation of metal in the rear of the breech-end of a gun, is true science, and of so easy an attainment, that wonder arises in the mind why it has not been done. The extent to which this principle is worked upon in our gunnery is very trifling, though recoil can by this simple arrangement, be nearly destroyed, or so lessened as to add a considerable per centage of range to the projectile. Add no considerable weight to the gun, but add it judiciously, behind the end of the chamber and vent, and immediately surrounding the breech. We have, on a small scale, with fowling piece barrels, tried this to a great extent, and find, by an additional inch of metal to the extreme end of the barrel, the greatest advantage arises; while, on the contrary, by reducing the exterior end of the breech, until it becomes of less thickness than the sides of the barrel, the contrary result is doubled. Guns will some day be constructed as mortars are, with the axles, or trunnions, in rear of the tube and of the vent, for by this arrangement recoil would act less on the mass of

metal forming the gun and bed, and less on the base from which it is fired. We are quite aware an arrangement of this nature could only be applied to certain descriptions of ordnance, and in certain situations. On forts, or batteries, commanding rivers and bays, and even on the bows of steam vessels, they may be placed with great advantage. Another objection will arise; you could not use guns fitted in this manner horizontally, or nearly so. Why not? The muzzle could be as easily raised or depressed as the breech, by mechanical means. We should much like, as we hope, to see the principle tried.

The following results of experiments prove, that if a true basis is not laid down, all the fabric raised upon it is but one of sand, which will crumble away from under us. Hutton says,—" Varying the weight of the gun produced no change in the velocity of the ball. The guns were suspended in the same manner as the pendulous blocks, and additional weights were attached to the pieces, so as to restrain the recoil; but although the arcs of the recoil were thus shortened, yet the velocity of the ball was not altered by it. The recoil was then entirely prevented, but the initial velocity of the ball remained the same." No doubt this was the result of his experiments by the pendulous suspension of the gun,—and here he erred; for had he suspended a thousand tons to it, without incorporating it in the gun, the result would still be the same, as all

the improvements effected, or yet to be accomplished, will be obtained by a concentration of metal. An excess of weight in the fore part of a gun is strictly injurious, by lengthening and inducing the tremulous vibration created by the explosion. The only necessity for strength forward, in a cannon, arises from the necessity of resisting the lateral pressure from the condensation of the column of air in the tube. The pressure of the explosive gases is, by the velocity obtained before reaching the fore part, of very little amount, from the short period it is exerted on the interior. Therefore weight, in the fore part of a gun, be it ever so great, will not prevent recoil if there is not a proportionate quantity behind. It will retard or lessen the distance to which the recoil will drive the gun and carriage, but the evil is then over. If the slightest movement occurs in the gun, the shot is projected from an unsound base or foundation. It is precisely similar to a man who, in the act of throwing a stone, slips his foot backwards, and the effect is at once apparent on the stone. If the trunnion of a gun breaks in the discharge, or a quoin flies out, the shot is materially affected, never ranging, under such circumstances, the accustomed distance, nor with its usual accuracy. But, in fact, practice with mortars proves it beyond dispute, for with a much less charge they project a greater mass farther. A mortar discharged on land, exceeds in range the same description of

gun on board of ship, or on the best-constructed platform. For in truth, this is but another truism of the law of nature: if you have not a solid fulcrum, it matters little what the power of your lever may be. Gunpowder is a lever if exploded on a solid base, if not, its effects become limited in proportion. Unquestionably, much may yet be gained by an economical arrangement of our projectile force. Great and rapid as has been the stride of knowledge in every thing relating to gunnery in modern times, there still remains, we have no doubt, an unexplored mine of valuable treasure to be added to the science.

To effect an improvement in the mortars used by the navy—not only to destroy the vibration and shake given to the ship, which it is well known is great, but to increase their efficiency and to aid the projecting power—would be to place them on beds of the softest lead, not less than twelve inches in thickness. Though this being but theoretical, experience would soon determine the least degree of substance available. The advantage would arise, in the first place, from the non-conducting tendency of the lead; in the second, from its density, and, of course, incompressibility. The one protecting the ship, the other being the most solid bed for the mortar that can by possibility be obtained.

The weight of a hollow 13-inch shell is 190 lbs.;

the bursting powder, 6 lbs. 8 oz.; the weight, if cast solid, would be 290 lbs., so that the action of so large a body on the atmosphere must be immense of itself There seems to exist much difficulty in projecting masses of great diameter from the above cause; and this should lead us, as indeed it points to, another material for fabricating projectiles. As weight is less in substance, and, of course, less in space, much less resistance, in proportion, will exist in a bore of six inches than in one of twelve; and a greater projectile force will be generated with fewer countervailing disadvantages.

The first step in the vast improvements about, and yet to be effected, in gunnery, has been successfully taken by Mr. Monk, of Woolwich arsenal, in having induced the Board of Ordnance (a great result) to allow a gun to be made and tried from drawings and calculations of his own. The dimensions of the gun are—length from casable to muzzle, 11 feet; weight, 97 cwt. 3 qrs.; bore, 7 $\frac{7}{10}$ inches; weight of solid shot, 55 lbs.; shell, 42 lbs.; windage, 0·175; charge, 16 lbs. of power; giving a range, at 32° of elevation, of 5327 yards. *A compound shot*, a shell filled with lead, was projected 5,720 yards, or *three miles and a quarter*, at a velocity, during the first second of time, of 2,400 feet per second, and occupying during the whole flight only 29½ seconds. The comparative weight of gun and shot is

1 to 220. This is a most splendid result; it is the forerunner of great and important changes. Thanks to Mr. Monk, he has broken the ice, he has taken the film from the eyes of the gentlemen who have for such a length of time placed their veto, their prohibition, on any improvement in gunnery. We must now go on: if we do not, other nations will; and hence *the pressure from without* may accomplish that which conviction is long doing.

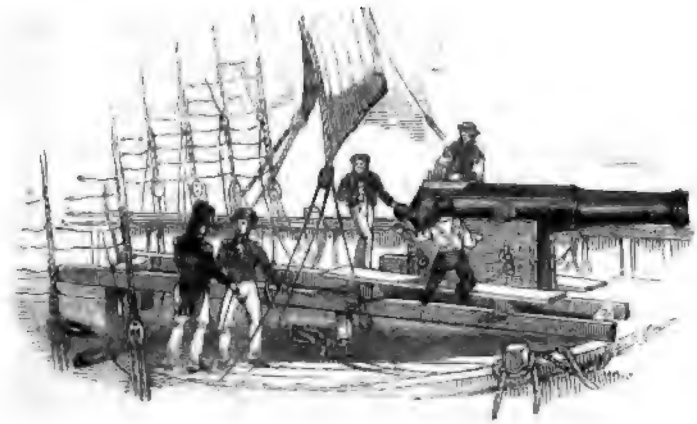
A course of experiments, extending over seven years, has firmly established this gun as the best ever constructed. Many attempts have been made to excel it, but all have failed, some not very creditable to the parties concerned. Guns, on drawings varying not more than three-tenths of an inch, have been made, and with extreme "*modesty*" the individuals have claimed a right to compete with Mr. Monk,—have asked and obtained competing trials,—contending thus with the principle, without any claim whatever to the discovery of it, coming into competition by no just claim or merit, but solely from the wish, seemingly inherent in all military men, to crush everything emanating from the "*civilian*;"—eighteen, twenty-four, and thirty-two pounders are now however constructed on this model;—indeed the improvement is so great and so apparent, as to overcome every difficulty as yet thrown in its way. The country ought to have conferred some

substantial benefit on the inventor, which we understand it has not yet done, but we hope will soon.

We have no wish to detract from the merit of Mr. Monk's invention. Indeed, we congratulate him upon it; but, in justice to ourselves, we may remind some of our readers, that in "The Gun," published early in 1835, we clearly laid down the principle, in *projectile force*, on which this gun is constructed; and if he has been so successful as to accomplish this great improvement, he must permit us to say, the principle is the same which we have striven for, for many years. Wilkinson says, "Guns cast on this principle, although several hundred-weight lighter altogether, recoil less than those on the old plan, with equal charges of powder and ball, in consequence of the weight being *properly* distributed." No doubt he had better have said *judiciously*. He falls, however, into a great error. He further says, "One remarkable fact attended these experiments, namely, that by increasing the windage a little, the range was increased also, contrary to the received opinion; but this may be explained by the circumstance, that with very great velocities, and long guns, the column of air to be displaced before the ball quits the gun is considerable, and is condensed so rapidly, that it offers immense resistance to the passage of the bullet, if it fit the bore closely; but, by reducing the size of the ball, and thus increasing the windage, the air has more space to

rush round it, and the ball escapes with greater facility." If the condensed air prevented the velocity being greater, it argues most clearly, that there was an insufficiency of explosive matter to keep up the velocity until the ball of less windage left the muzzle; and the result, with the ball of greater windage, establishes this assumption. For if the condensed air was allowed to pass the ball by the windage into the tube, it proves beyond doubt that there was a deficiency of matter there, or that the pressure without was greater than that within. How otherwise could such a result occur? It is a clearly established fact, that with the generality of ordnance, a full waste of one-fourth, if not more, occurs, by the *elastic fluid* escaping past the ball by the windage, instead of the reverse. Neither could the condensed air rush into the gun by the windage if there are any *permanent gases* generated, which Mr. Wilkinson himself says there are, to the extent of "250 times the bulk of the powder in grain." These would offer a sufficient resistance to prevent the condensed air rushing in. We have found, by experiment, before described, that a ball driven against a column of air, which has no escape, if the velocity is trifling, say 800 feet per second, the air will escape by the windage; but double this even, and it is so condensed as to form a cushion for the ball to strike against. Then how much less will the chance be of it escaping, if the velocity become

two thousand four hundred feet per second. No, the cause is remote from that of Mr. Wilkinson's supposition. There is a want of force,—an accelerative propellant force,—which should continue to the end of the tube, be that length ever so great, and on this point, for one, hangs the whole future improvement of gunnery.*



The result wished for, can be obtained by a systematical arrangement of the granulation of powder. That a much greater velocity than is obtained in this gun, the greatest in any piece of ordnance in

* The above cut is intended to convey an idea of the immense size of this gun and carriage. We have placed it on the forecastle of a steamer, feeling quite convinced *that* will be eventually, its fit and proper situation. The present arrangement is to place this gun on promontories and headlands of maritime districts, to prevent any attack from steamers, and for other purposes for which its extreme range fits it.

use, and possessing a greater range than has been obtained by any power in Europe, may and will be exceeded, we fearlessly assert; we have obtained a velocity with an ounce ball nearly doubling this; and though, as it will be argued, this may be too limited an experiment, yet let us not forget that great results most frequently spring from little causes. Large rivers owe their origin to small springs, and if the same principle by which we can penetrate a plate of iron, half an inch thick, with an ounce of lead, is fearlessly and judiciously carried through, we may, and no doubt we will, live to see the accomplishment of projectiles being thrown 5¼ miles; that this will be difficult to accomplish we deny, no difficulty attends it.

The great principle in a propellant force, is so to arrange it, that you obtain not too great a velocity at the first move of the projectile, as no mass can be put from a state of rest to a high state of motion, without communicating to the gun a corresponding motion, which will create a recoil, and the greater the motion the greater the recoil. If the explosive matter merely expands for a short period, and is burnt out before the shot has reached midway the length of the gun, the velocity there acquired will be reduced by the condensed column of air, in the other half of the barrel, to the velocity it possessed when only one fourth the length of the whole from the breech, consequently it would be advantageous

to cut the gun in two at the middle, as a greater force would be then generated advantageously, than by the whole. But if you so arrange the granulatory system of your powder, that it shall proceed into motion more gradually, a rapidly increasing force of elastic fluid continuing to be generated until it reaches its greatest maximum of velocity, which it should do as the ball leaves the muzzle,—then you obtain with your means the greatest benefit.

We believe that the generality of gunpowder used by our government, is vastly inferior in strength to some made by private makers; yet it is not advisable to jump from one extreme to another. What is wanted, is the proper blending of the qualities; an addition of a quantity of Harvey's quick powder to a charge, when it has driven the ball up three-fourths of the tube of a gun, and probably had acquired a velocity of 2000 feet per second, might so aid it, that it would leave the muzzle with a velocity of 3000.

You put not a locomotive train in motion at once; if attempted, you break and fracture the whole carriages; but if you gradually add your force, you gain in time the greatest possible velocity. We have drawn a parallel case,—it is the same with gunpowder, only the velocities are widely different. Therefore, we may be pardoned, if we say gunnery is, but as steam, in its infancy. Let us but clearly

see and understand aright the principle,—knowing that the greater momentum the less the action of the atmosphere,—and if 3¼ miles can be obtained with a ball 60 lbs. weight, 5¼ may be easily accomplished by a ball of 120 lbs. Powder is made and can be had that will do this.

The use of compound-shot has of late years become quite common in experiments: why lead has not been more extensively used as a projectile by large guns, has always appeared to us extraordinary. Its weight and density peculiarly fit it for this purpose, and its non-conducting principle is its greatest recommendation. Why is it? In no instance, except as compound-shot, do we find any record of its use on a large scale, save in Sir Howard Douglas's "Naval Gunnery," who in a note says, "A very distinguished naval commander mentioned to me that he knew a person who had served in an American privateer, which, being out of shot, and unable to procure a supply of iron balls, used leaden shot as substitutes. This person always mentioned with great surprise the superior effect of leaden balls." So he might; for we need not tell the reader that its greater specific gravity would add to its momentum, and a longer medium velocity be retained during its flight. But it possesses another recommendation, superior to all these, in warfare. That of communicating to the body struck all its force, all its velocity, be they ever so great. Iron does not possess this

recommendation, except to a certain extent, and that at low velocities. Hence the cause of it being found in naval warfare, that low velocities damage and destroy a ship's sides more than higher velocities, even if passing quite through. Lead, in the act of striking hard substances, iron or stone for instance, is partially flattened until the flat is nearly equal to the diameter of the sphere of the ball, and thus it parts with all the force it struck the object with; in most instances falling motionless at the base of the object struck, while in the stone the surrounding crystals or grains are, by their abrasion on each other, pounded into dust, in proportion to the size and force of the body of lead striking them; in many instances, to many times the shot's bulk, and only flattening the lead, less or more, in proportion to the capability of the stone to resist. Iron, striking the same object, retains its shape. The grains are driven back upon each other, and each offering its proportion of elasticity, the ball is enabled to rebound back, which it does in many instances to a considerable per centage of the whole distance it had been projected. The greater the velocity with which an iron ball is projected, the greater the rebound back from a hard substance, such as stone. On the reverse, the greater the velocity of lead, the greater the effect on the object struck. Walls or fortifications struck by leaden balls at the same velocities (waving the

advantage to lead by its greater specific gravity) would be pounded into sand by less than two-thirds the same number of lead as iron shot. Any unprejudiced person may soon satisfy himself of this, by trying it with a musket or fowling piece. A leaden ball will pound itself a hole many times its own size, while an iron ball will not make a hole half its size.

We have tried many experiments to ascertain the penetrating powers of iron and lead relatively, from striking a boiler plate of half an inch thickness, down to fir deals. The same size of lead will, under certain circumstances, punch a perfect hole in a plate of that great substance, as we shall have occasion in this work to show. While, under precisely the same arrangement, the iron ball would rebound back with very little diminution of force; and if the plate of iron be at a perfect right angle, the ball would nearly return into the muzzle of the gun. In truth, we had a near escape seven years ago, from a bullet actually cutting the rim of our hat: so that it will be well, if experimenting in this way, to be sure the *person* is well ensconced, for fear of *unpleasant* results.

Lead, therefore, for destroying ships, as well as walls, is unquestionably highly advantageous, if even projected with the same velocities as at present adopted for iron. The additional weight would not decrease the destructive effects; it would augment

them. We perfectly agree with the American *privateer*, that their wonderfully destructive powers will create surprise, whenever they shall come generally into use. Imagine the effect from a gun of the dimensions of a 10-inch bore. It is dreadful to contemplate.

The effect of lead will be easily understood when explained in the following way. If a 36 lb. shot have a velocity of 2000 feet per second, the force is equal to the velocity multiplied by the weight, or 72,000 lbs. The whole of this force would strike a wall, and be left there, if communicated by soft lead; if by iron, at the same velocity, it would be minus the amount of force required to make it rebound to the great distance iron invariably returns. Though created by the elasticity of the iron itself, this must be deducted from the effect produced, and hence arises the great advantage the lead possesses. We are aware that iron driven with a slight velocity rebounds less; true, and less is its real effect, for under the very same circumstances would the great advantages of the lead predominate. It may be objected, that lead is too easily misshaped; we deny it. At low velocities it might, but the greater velocities diminish that chance, as it is a well known fact that all dense incompressible bodies are least affected by an extreme sharp motion. There is nothing so equal in its propellant power as gunpowder; it is the *acmé* of cushions; it expels

without injuring in the least, and let the body of lead be ever so great, if it retain its incompressible nature, the explosive fluid from gunpowder will never alter it in the least. It could not be urged as an objection, if it does become misshaped in striking a ship's side,—which to a certain extent it will do,—if projected at a low degree of impetus, but rather as an advantage. All our arrangements in warlike preparations, at present, involve great weight of projectile for fracturing, not perforating. During the siege of Ciudad Rodrigo, 2159 rounds, of twenty-four and eighteen pounders, were requisite to form the small breach of thirty feet wide, and 6478 rounds for the larger of 100 feet. At Badajos there was expended to form three breaches of 40, 90, and 150 feet respectively, the enormous amount of 31,861 rounds of the same sized iron shot. We may be pardoned if we presume to say, one-half the number of lead shot, would have done more and done it better.

If we bear in mind, that the whole round of experiments, from which Hutton drew his deductions, were conducted with iron projectiles, the inconsistency of taking his data as the standard will be apparent. The dissimilitude of specific gravities being great, namely, 7425 and 11,327,—or one-third difference,—it clearly shows, without any effort of the imagination, that the range must be in the same proportion, with the addition of greater momentum. For it will scarcely be denied, that a ball of gold

or platina, from the same cause, will maintain a velocity longer, and consequently range further, than even lead. Hutton's theory only establishes the principle, that the lighter the body projected, the sooner it is acted upon by atmospheric resistance, and a medium velocity induced. We cannot attribute his preferring iron, to arise from an opinion of its penetrating to greater depths; for a man of his extensive knowledge and research could scarcely be guilty of such an error. But even in our enlightened times we are told elephants cannot be killed with any projectile but steel. Leaden balls cannot do it: we should like to try, and receive the *tusks* as our hire.

The Sharpnell shell, (invented by Gen. Sharpnell,) or spherical case shot, introduced into the British service of late years, is probably the most destructive of any missile in use. It was intended to supersede,—which it has done,—canister and grape shot, effecting the same results at treble the range. The construction and principle are very simple, being merely a shell of an unusually light description; in fact, little more than a light cast-iron hollow ball, with a fuse hole. A certain quantity of leaden, or iron bullets is put into it, and the interstices around the balls shaken full of powder, a fuse of the length required is inserted, and explodes the shell during its flight. The peculiarity being, that the body of small balls retain their medium velocity and travel

on, merely diverging, laterally, like an immense charge of bird shot. They are usually fired from howitzers, carronades, and other wide bored-guns, at or near horizontal ranges. A considerable delay occurred before they were successfully perfected. It was found that when the small balls did not pack perfectly tight, or over tight, the case frequently exploded in the gun: occasioned, no doubt, by the friction creating a spark at the moment of the howitzer being fired, and thus exploding the shell before its time; but we believe such an occurrence rarely happens now.

We can conceive the immense slaughter that must ensue in dense columns of men, from the use of this shell. Neither is distance any safety short of the actual range of the gun, for it may be exploded as effectually at 15,000 yards, as one half. Congreve or other rockets are in increasing repute by almost every nation. A considerable degree of secrecy has always existed as to allowing any knowledge of their composition; but we are not aware it is required, for if a person be possessed of a sufficient knowledge of the nature of gunpowder, he will easily conceive that the only secret consists in the mechanical mixture of bituminous substances with the composition. These having a tendency to lengthen the period the flame of the mixture burns, and thus making the propellant power more perfect. They are capable of being the means of conveying

combustible matter, or explosive substances, to almost an indefinite extent.

That a considerable improvement will some day be effected in shells, by the introduction of a principle of exploding by percussion, there can be no doubt. It will be safer and more certain for every description of projectile of this nature, with the exception of the spherical case shot, which is intended to explode during its flight. Lead is the material capable of this improvement; and it may be effected by a sphere inserted within the globe of the shell, but of considerably less diameter. This being covered with a coat of fulminating powder, and the space between the bodies being filled solidly with bursting powder, it would prevent the fulminating mixture exploding when in the act of being driven from the gun; and not be a sufficient hindrance, when the shell strikes the object and collapses, to the percussion, igniting the whole, which it certainly will do. Several years ago, we tried a variety of mechanical arrangements, to obtain a good shell of this nature,—only—on a small scale, but none answered so well. But, however, we would not advise any one to expend his time or ability on this subject, as the most likely result would be in having the improvement laid on the *shelf*. The Board of Ordnance have a very *large shelf* for this purpose; and sometimes they overhaul the con-

tents, when they expect they are forgotten—not the most liberal way certainly.

A recent series of trials with the concussion shells is a proof of this; every one of the plans, and, we believe, there were five, were alterations of the principle embodied in a fuse, invented nearly seventy years ago by "Wilton," a person employed in the laboratory at Woolwich, and which has been stored away until the present day. But, however, there is another, either now in trial, or will shortly be:—a plan proposed by the late Joseph Manton, of applying the principle of a rifle to artillery. His idea was, that if a motion on an axis, parallel to the horizon, could be given to cannon balls, they would range farther and with greater accuracy; but as there exists great difficulty in causing the rifling in a gun to act upon an iron ball, he constructed a cup of wood, into which the ball was fitted, projections were made upon the wood to fit into the groves of the rifle. The spinning motion thus being communicated to the ball by its wooden adjunct. The result was twofold, for the expansions of the wood during the explosion, filled the tube of the gun tight, and effectually destroyed the windage. The government of the day did offer him a premium of one farthing each, but "Joe" over-reached himself, asking the sum of £30,000 down; this, they refused: and the patent was allowed to expire without the government taking any advantage of it.

However, this principle is now about to be revived again, and very probably, ere this work is out of the press, we shall have startling announcements of improved practice, with a new-shaped ball as we have already had on rifle shooting, by Mr. Lancaster; the same shaped bullet, precisely, having been made and experimented upon by ourselves more than ten years ago.

The directors of England's "*war-marine*" still cling to the absurdity of thinking weight of projectile preferable to range. The example the Americans showed us, that long guns were most preferable "for playing at long bowls," has been completely forgot, and is now unheeded. True, we have our steam marine armed with two large guns, on General Miller's plan, of a ten-inch bore, throwing a hollow shot or shell of 86 lbs. weight, with a range of 1500 yards, yet this is not to the extent the exigencies of the service require. A steam vessel, whatever may be her power, can never be placed alongside a first-class ship, with all her teeth displayed. She would be in splinters, and in as many fathoms deep, in as many minutes No steam vessels are destined to alter, to revolutionize, the present system of warfare; but it will be by playing at "long bowls," as represented by the accompanying engraving. What will be the situation or fate of any large fleet of first-rates, in any moderate description of fine weather, *if two steaming locomotive*

Drawn by J. W. Carmichael

Engraved by T. E. Nicholson.

FUTURE NAVAL WARFARE.

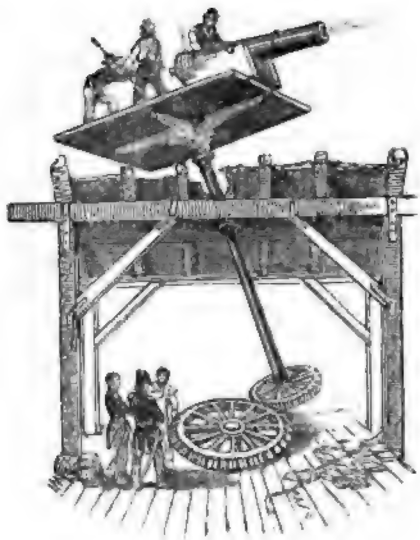
volcanoes can keep in their *wake*, making a target practice of them, without their having the power of returning it. Assuredly it will come to this. And, as a matter of necessity, let steam vessels have Monk's gun, not Miller's. A seven-inch before a ten-inch bore, and 5000 yards range in preference to 1500. A question may again arise, cannot a fleet of first-rates have steam boats with them? True. But hawks do not pick out hawks' eyes: and if they did, then you had better fight with hawks only. Why employ eagles, if the hawks outfly them? England stands on the apex—she may fall, but it will be by the stupidity of her guides if she does. Her steam-marine stands unrivalled. She is adding to it daily,—and long may she: for these must bear the battles' *brunt* for the future. The *floating cities* may make a display, but their day is passed. This principle must, and will be, adopted sooner or later by all the maritime powers of the world, and that we should *lead* the way in improvement, must be the wish of every Englishman.

Some years ago, the writer laid before the Board of Ordnance a plan of an *expansive* ball of a very simple nature. It is merely an oblong leaden ball, with one end flat instead of spherical. A perforation of a conical description extends to within a short distance of the spherical end. A conical plug (of dimensions greater as may be the wish to obtain an increased expansion of the outer circumference

of the oblong) with a head, of dimensions which if placed against the end of the oblong, would make it correspond with the opposite half sphere. It is slightly introduced into the cavity, and the gun loaded. Either the explosion of the powder drives this plug home, or the action of the column of air; as its end is in or outermost. The outer diameter is expanded, the windage is destroyed, and the mass projected both with greater accuracy and force. The plug, of course, is not all lead, but a mixture of tin, zinc, and lead, in proportion to the hardness required. It was originally intended for rifles, muskets, &c., under which heads it is more fully enlarged upon. The only objection ever made against it was, that it being a compound, was not so likely to be efficacious. *How opinions change!*

Sir Howard Douglas, in his treatise on Naval Gunnery, impresses strongly on the authorities, the advantage of schools or depôts, for teaching naval gunnery. His wishes have been carried into effect to a great extent. A ship, the "Excellent," at Portsmouth, being especially appropriated for that purpose, and various other land depôts exist in other parts of the kingdom. The great accuracy obtained in large gunnery on board of her is truly astonishing, no doubt arising, entirely from the *excellent* arrangements of the commander, Sir Thomas Hastings. To show to the curious in these matters, how artificial means may be substituted

to imitate those of nature, we have added the present wood cut.



It will be perceived that the platform on which the gun and gunners are placed, is subject to motion by the *planet* wheel traversing round the *sun* or centre wheel, exactly resembling the roll of a ship at sea. Men are trained to balance themselves, and to take aim at a given object with these guns, without the waste of powder or ball. And when, as in the improved percussion plan they would do, a landyard is pulled, the platform is fixed, and the gun pointed in the way the ability of the tyro allowed him. The instructor inspects the line of aim,

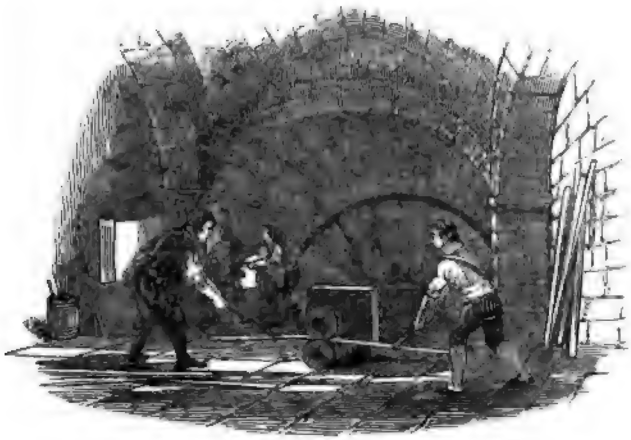
gives his instructions, and the machine is again in motion. On the score of economy, this is an excellent arrangement. May this and such like improvements continue, and England's marine may play the game as they have done before.

A serious accident occurred on board the "Excellent" some months ago, from the fuse of a shell igniting; and as a much more serious one took place on board the "Medea" steam frigate, at Alexandria, we may be excused suggesting the probable cause of this. The cap and socket of all fuses of this nature are brass, covered with tin. Now, when the cover has been screwed on for a considerable time, there is a kind of cohesive action takes place between the two surfaces of tin, and the application of the lever, which it is necessary to use to unscrew the cap, exerting a great force, the rapid friction created heats the smaller particles adhering together, and those the ends of the fuse. A supply of varnish on the coat of the tin or the use of anti-attrition grease would prevent the recurrence of any such accidents.

Percussion has been for some years introduced into the service, for igniting the charge of all large guns. Many plans have been invented or constructed. The author believes he was nearly the first, or at all events one of them, who laid before the Board of Ordnance any thing approaching feasibility. To enumerate the half of them

would be both tedious and unprofitable. The only one which has succeeded is by the late Mr. Marsh. It consists of two quills, a goose quill and a smaller description. The smaller is secured to the end of the larger at a right angle, forming in appearance the letter T, with one arm off; the small part is filled with a percussion mixture, perforated; the large part or shank of the T is filled with a composition of mealed gunpowder and spirits of wine, also perforated. The whole is covered with a coat of sealing wax to protect it from moisture. When fired, the larger end is inserted into the vent, the smaller lies at right angles, to the length of the gun on the vent field, where it is struck by a hammer of a peculiar shape, pulled by a land-yard. The result is in principle the same as firing a pistol into the bung-hole of a cask of gunpowder. It will ignite, after penetrating two thicknesses of flannel, gunpowder at four feet distance.

One valuable improvement is contingent on the success of the percussion system in cannon. To parties unacquainted with the action of gunpowder in large guns, it may seem exceedingly strange that so many plans have been produced, and so many failures have occurred. But it will no longer be so, as we can assure them that we have seen a 24 lb. ball projected 50 feet into the air, by being placed upon the vent of a heavily-loaded-24 pounder, and yet the diameter of the vent is only two-tenths of



CHAPTER IV.

ON THE MANUFACTURE OF IRON FOR GUN BARRELS.

A CONSIDERABLE progress in improvement has taken place in manufacturing the higher quality of iron since the publication of "*The Gun;*" not that we arrogate to ourselves any credit on that score, but it is evident that good frequently comes of *flagellations*, whether on the body or the mind. One part of human nature will ever fear the exposure of bad properties, while another is emboldened to advance in improvement if the slightest chance exist of suc-

cess or encouragement. Thus we often see men, strive with one invention on the back of another, with wonderful perseverance, finding many blanks, and rarely a prize; for truly in this competing age, the mind must be strong that can fight long. Bitter is the disappointment of the truly ingenious soul, to see the produce of his brains thrown as lumber into the *herring barrel*,—as the printer terms the receptacle for what he sets no value on;—and the valueless productions of the mean and sordid preferred and rewarded, because they enable the manufacturer to produce cheaper, by foisting on the public a fraudulent or a spurious article. All inventions for the purpose of deception, are readily, aye, eagerly, patronised; for they return gold to the coffers sooner.

The improvement in the manufacture of gun-barrels depends on the quality of the iron entirely; for it would be a useless waste of time to endeavour to make a good barrel of inferior metal—as easy to "make a silken purse out of a sow's ear." Science with experience have worked a wonderful change in the mixture of the superior qualities of iron; for we have had announcements of silver-steel barrels *only ten guineas a pair*, in the rough; Brescian steel barrels, carbonised iron, and we know not how many more descriptions or compounds of metals, to form the best material for high-priced barrels. We have now metal which, in the rod, cannot be sold for less

than one shilling and twopence per pound: the iron for a pair of barrels thus costing sixteen shillings and four pence. This is good—'tis more than good —'tis grand. But on the other side of the picture, we would we could draw a veil: yet it must not be —already we are on the balance. Belgium, France, Holland, and Germany, are improving, are marching onward, and we, alas! are decidedly retrograding. Competition and villany combined, are driving our gun-trade into a labyrinth, out of which we doubt not it will be long ere it finds the clue of exit. Our manufacture of inferior gunnery has certainly reached a depth of infamy which never any other manufacture in the world reached, nor we hope ever will.

During the existence of the slave-trade, there were made many thousand guns per year, of what is, by the trade, technically termed "*park paling*," being only fit for such purposes, and the cost of which was only *seven shillings and sixpence* each *spike;* but now we can furnish the Brazillians and others, who still imagine they hold a right in the blood of their fellow-men, ship loads, if they choose, at only *five shillings and sixpence* each, and it is still supposed one of these *imitations* is the blood-money for a fellow-creature. It would be a just and equitable law, if our legislature would pass it, "That every man should fire the guns he manufactures," nothing would tend to improve the quality of the guns of a low grade more.

The conscience is most sensitive, when there is danger *in a deed;* a certainty of no untoward consequences renders it callous; but why talk of conscience, either on the part of the maker or the vendor; the word is not in their vocabulary. Neither is there strictly any law to control them. We are aware there is an act of Parliament to enforce the proving of gun barrels; aye, two proof-houses; two acts of Parliament; but what of them, they are no more than waste parchment for any real or true benefit they confer upon the community. The Birmingham *trash* manufacturer cares as much for their stringent powers, as he does for the furious edicts of his most *Celestial Majesty*, backed by his *fierce warriors* with all their gongs. He knows neither can reach him, and if they did, as they have sometimes hauled up before the magistrates a *sinner*, more open with his villany than the generality of his *fellows*, and sometimes have succeeded in obtaining a conviction, but in what? why the enormous penalty of "*forty shillings.*" It must be a notorious misnomer to call that a law, which imposes the enormous penalty of not exceeding twenty pounds, and not less than twenty shillings, for *forging* the proof marks of either of the two proof-houses; a cause productive of effect in the loss of hands, arms, and frequently the lives of our fellow-creatures. It seems strange, passing strange, that he who deprives another of a few paltry sovereigns, by the forgery of

his name, forfeits his liberty for the rest of his natural life; but he who forges the proof marks on a gun barrel,—and is frequently the cause of the loss of the hand of a fellow-creature, the means of bringing many a family to the workhouse,—for it is in this case the poor man who mostly suffers; the very low price suiting his means best; is punished with, *if detected, a sum not exceeding twenty pounds.* We imagine no case; we have an instance, nay two, before us, if we wish it every day. One a sawyer, a hard-working, honest man, used at a sparrow shooting match one of these *infernal* machines, it burst and shattered his left hand so dreadfully, that amputation was required immediately; and in another case, a gentleman's gardener shooting blackbirds, to preserve his cherries, suffered the same result; but to go further, on occasion of shooting for a plough, at a village in Westmoreland, not yet eleven months ago, a burst took place, depriving the shooter of a hand, and a byestander of his life, by a piece of barrel entering his skull; indeed we could repeat instances enough to fill half this volume if requisite.

We are sorry to record it, but it is only one more instance of the brotherhood liking the *moniesh,* that an immense distribution of what is quite equal to Fieschi's machine, is to be attributed to the Jews for the mock sales, "*on bonâ fide consignment,*" that stare us in the face at every turning, both in

the metropolis and provincial towns, as a means of disposal most suited for such *wares*. To see the easy gullibility of men, even some clever mechanics, is matter of wonder; they will give, for a painted combination of wood and iron, thirty shillings and up to two pounds; a thing which costs the *Jew* fourteen pounds per score; for this is the price of the generality; to all appearance twisted barrels, but of course not so, only *veneered*, about which we will discourse hereafter. If you want a double, they can *oblige* you; for these they can get at the *enormoush* sacrifice of twenty-two pounds a score. Oh, for a whip to *scourge*, not the body, but we forget—there is none, all is a void.

A considerably increasing difficulty attends the obtaining of horse-nail stubs from the continent. The skill and ability of the barrel-makers, in various continental markets from whence we draw our supply, have increased; and a desire to patronise superior productions gaining ground on the part of many continental sportsmen, have taught the foreigner the value of their old horse nails, and hence their increased scarcity. The inferior iron we use for the same purpose, prevents entirely the adoption of our own, so that it requires no foresight to prophecy that our manufacturers will soon resolve themselves into two descriptions, the very best and the very worst. The latter is already active and lively, the other approaching; as no doubt an increasing desire

to obtain the most perfect gun, pervades the thinking and affluent portion of the sporting world.

The manufacture of iron is a science truly worth the consideration of the philosopher, for it is fraught with the greatest advantage, either considered as a material of commerce, or the means to an end. In advancing manufactures and the progress of improvement, it has had an effect on civilization not equalled by any known product, gold not excepted, for no substitute exists for it, or ever did. No doubt the ancients had their bronze, of which they could form edge tools, even razors, but that was a mean and limited use of cutting tools enough perhaps for war or subsistence, but not for the progress of the arts.

Of the first discovery and use of iron we have no record; though its value may be presumed from the fact, that Quintius Curtius mentions "That Alexander of Macedon, received a present from Porus, an Indian chief, of about 30 lbs. weight of steel." If this were a present fit for the conqueror of the world, its value, even at that early date, must have been great indeed.

For many centuries, up to the sixteenth, all iron was produced by the aid of wood charcoal; and with such contracted and limited means, it was found that not more than 50 per cent. of the metal contained in the ore was extracted, and at this day all the ancient deposits of *slag* are sought and re-smelted, yielding a handsome return to the manufacturer.

The adoption of coal-coke was a matter of necessity, but has been productive of extensive benefit in all manufactures of iron of medium quality ; and the opinions of many men of science lead to the belief of higher also, but we are quite satisfied of the reverse, the quantity obtained in the yield formerly was, as shown, only 50 per cent. of the quantity existing in the ore, but yet it was the purest metal; for it is unquestionable, that the best is soonest fused. The ore of Britain is, beyond a doubt, inferior to that of many parts of the world, as all attempts to produce good steel from it has been attended ultimately with disappointment. For, to quote from Mr. Mushet's excellent work on iron, who says, "The successful exertions of individuals have increased the manufacture of cast and malleable iron beyond all precedent in this country; nor have we been without some enlightened individuals, who have laudably endeavoured to form a superior quality along with the extension of their manufactures. Success has so far crowned their praiseworthy exertions, aided by the operation of knowledge, in removing the prejudices of the artisan, that bar iron of our own manufacturing has been substituted to a great extent, in place of that formerly used of the Swedish and Russian marks, but hitherto all attempts have failed to make bars of proper quality, to form steel in any degree comparable to that we daily manufacture in great quantities from foreign iron."

"Here we remain at an immense distance behind; and while our manufacture of iron goods exceeds the collective exertions of all Europe, we humbly feel our dependence upon two foreign markets for the supply of that steel-iron, without which the beauty, the utility, and extent of our hardware manufactures would be essentially injured and abridged."

"The policy of the foreign holders of this article communicates many undue advantages to the favoured few, to whom the steel iron is consigned in this country. The rapid progressive rise in value of this iron, for ten years past, has already nearly doubled the price of steel to the workman, and given the trade in general a melancholy foretaste of the evils of dependence and *monopoly*."

So is it with the scrap, requisite to form good iron for gun barrels. We have had several pair of barrels sent from Berlin, and Vienna, to be fitted up in the English style, with a certain knowledge, that they wished for patterns in doing so: and in justice let it be said, the material and figure in the barrel were most beautiful. A variety of Damascus, or fancy pattern in the metal, *superior* to any thing seen of this country's manufacture; true, it is not requisite, being more for appearance than utility; but the fact clearly shows the industry and will of the artisan. The iron too, in clearness and density, we can scarcely surpass; therefore, if we regret we

are not advancing with our competitors, it proceeds from a clear conviction of the truth that we are slumbering upon our fancied superiority. A friend, the other day, informed us he had lately visited Lyons, and that in one gun-maker's shop alone, were employed fourteen of our best workmen; in fact, he brought with him a gun, which attests the great improvement the French have made of late years. We have, within a very few months, had possession of three guns, bearing on the lock and barrels, "Joseph Manton, London;" "Joseph Egg, London;" and "John Manton and son, London;" each of which were manufactured in Belgium, and so well is the imitation executed, that it would puzzle most amateurs to discover the fraud.

In fact a few months ago when in Liege, we were shown by a gun maker a gun, "marked" "Westley Richards, Bond Street, London," a good imitation indeed, and on enquiring what market he had for them, he candidly assured me he had sent twenty six to London, within a few months and which met with a ready sale, of course at half "Westley Richards's" price. What are our Custom House authorities about? foreign manufactured guns are always understood to be prohibited.

Within a very short period, a company, entitled "*The Indian Iron and Steel Company*," has commenced importing and manufacturing iron and steel

from Hindostan, ore, and native-made bar iron.* If they succeed in competing with Sweden and Russia, it will be a valuable acquisition to the British empire. They have already issued a quantity 35 per cent. cheaper than the latter, but quality is the end they should strive for. But the business is in able hands, and we have no doubt, under the intelligent direction of Mr. Heath, (the first projector of the Indian iron-works) that object will be kept prominently in view.

Foreseeing the difficulty that would eventually beset us in obtaining a sufficient supply of old horse nails from Germany and elsewhere, we, soon after

* The fine quality of the Indian Steel is generally acknowledged. The iron is first obtained by smelting, in small quantities, the wootz-ore, or the magnetic oxide of iron, and which is found combined with about 42 per cent. of quartz, the yield being, out of 100 parts of ore, only 15 parts of metal, but this is of the finest character.

The process by which the iron is converted into steel, is as follows, and fully accounts for that peculiar quality for which the Indian steel is valued.

The iron is cut into pieces and packed closely in a crucible of clay, containing about 1 lb. only of the iron, mixed with a tenth part of dried wood, cut small, the whole covered over with green leaves. The crucible is then stopped, by covering the mouth with tempered clay, so as to effectually exclude the air. After a time, that is, as soon as the clay-plugs are sufficiently hard, from 20 to 30 of the crucibles are built up in an arched form, placed in a small blast furnace, and kept covered with charcoal; thus being subjected to the heat of the furnace for two or three hours. The process is then complete.

the publication of "*The Gun*," turned our experiments to steel entirely; perceiving during our former course, that where the greatest quantity of steel existed in the mixture necessary to form material for best gun barrels, there also existed the greatest tenuous strength. We had then a decided objection to all steel, as the following quotation from "The Gun" will show:—

"We recommend hammer-hardening in all mixtures containing iron. If you throw the iron aside, and confine your manufacture wholly to steel, it would be an evil, from this simple cause:—steel is of itself close enough in the grain; hammering it, therefore, in a cold state, only tends to make it more brittle, but the reverse is the case with iron; the more it is beaten the greater becomes its tenacity;

As soon as the crucibles are cool, they are broken open and the cakes of steel are found rounded in the bottom.

The top of the cakes should be found covered with striæ, radiating from a centre, and be free from holes or rough projections. If the cakes are honeycombed, the process has been imperfect and incomplete. When re-melted and tilted into rods, a very superior article has been the result.

The natives prepare the cakes for being drawn into bars, by annealing them for several hours in a small charcoal furnace, excited by bellows; the current of air being made to play upon the cakes while turned over before it, whereby a portion of the combined carbon is dissipated and the steel probably softened, without which operation the cakes would break in drawing them. They are drawn by a hammer of only a very few pounds weight, but the repeated hammering greatly tends to the production of a highly condensed and perfect article.

and when mixed with steel in the way the stubs-composition is, it prevents the particles of steel from becoming too hard. This has been fully proved. A celebrated barrel-maker, in Birmingham, has been making doubly refined hammer-hardened steel barrels, single refined steel barrels, &c. &c., for which, in the rough, he has had the conscience to ask the moderate sum of ten pounds a pair. These, when proved in London, have stood the proof, but when proved in Birmingham, have been blown to atoms. How is this, it will be asked? The reason is simple —when proved in London, the barrels are generally put together, and, consequently, the hammer-hardening has been destroyed by heating them red hot to brase the ends, (which, by the by, proves two of our positions, if proof were wanting); when proved in Birmingham, they are generally proved singly, previous to the brasing at the ends, &c., and with the extreme hardness given to them by hammer-hardening, still existing. The cause of the failures of these plans,—for failures we must call them,—is a want of the knowledge of metals. We admit that the harder a barrel is, the better it is calculated to shoot with a cylinder bore, or without any artificial friction, from the smallness of the expansion; yet in endeavouring to obtain hardness, you must not destroy your strength or tenacity, or you increase the danger of bursting. This is what these inventors, as they term themselves, have lost sight of: they ima-

gine if they stand proof they are safe—a fallacious idea—the present proof being no test;—therefore we again say, the mixture that will stand the greater tension in the rod, will make the safest, and, consequently, the best barrels for all purposes. But if you quit iron without finding a better substitute, you step over the line of demarcation: as we are fully convinced from experience, that an equal substance of the best steel ever invented or made, is less in tenacity than a mixture similar to stubs and steel—for instance, when testing a bar of steel with the testing machine, we have struck it with a small hammer, and it snapped like a piece of glass, while a bar of the same size, made from stubs and steel, would bear a stroke twenty times the weight. This completely proves that if you want safety, you will not find it in steel barrels. The reader must not infer from this that we disapprove of steel in a greater quantity or quantities than what is at present used in the manufacture of the best gun barrels. In fact, we think that a greater quantity of steel with the stubs would be a decided improvement. Go on improving the tenacity of iron in the rod, and you will improve the quality of your barrels."

The above is correct, as a considerable difficulty had to be overcome ere steel could be rendered available. Mr. Whitehouse, of Wednesbury, spent a considerable time in his endeavours with but trifling success, and has now adopted new Swedish iron,

which he terms Brescian steel. The way in which he has succeeded in obtaining a figure, or as late writers have termed it, "Watering or *Jowher*," attests the attention and assiduity he must have devoted to the subject, for the variety is great and handsome, but wants that distinctiveness which cannot be obtained from iron, of similar density, and without dissimilar proportions of carbon.

Mr Adams, of Wednesbury, and Mr. Clive, of Birmingham, manufacture a considerable quantity both of silver-steel and common twist steel. The difference merely consists in the variety of tortuous twisting the former undergoes, while the latter is rolled out into rods of 6-16ths broad, with the fibres running perfectly longitudinal. The method of making or welding the pieces into a bloom, is in the following way. Having collected a sufficiency of mild steel scraps, such as cuttings of saws, waste from steel pen-making, old coach springs, and the immense variety of pieces arising from the various manufactures of tools, they are cut into pieces of equal dimensions, polished in a revolving drum by their friction on each other, until quite bright, and then placed for fusion on the bed of an air furnace; the parts first fused are gathered on the end of a similarly fabricated rod, in a welding state, and those, gathering together by their adhesion the whole, as they become sufficiently heated, until the bloom is complete. It is then removed from the furnace,

and undergoes the effect of a three-ton forge-hammer and the tilt, until it forms a large square bar, it is then re-heated, and thence conveyed to the rolling mill, where eventually it is reduced to the size of rod required. We have generally the metal required, cut into short pieces of six inches long. A certain number bundled together and welded, and then drawn down again in the rolling mill, and this can be repeated to any number of times—elongating the fibres and multiplying their number to an indefinite extent as may be required.

The great advantage derived from the air furnace welding, in this instance, is a chemical one; for while the small pieces of steel are fusing on the bed of the air furnace, the oxygen is extracting the carbon, and leaves the resulting metal, mild steel, or iron of the densest description; while the succeeding hammering and rolling and re-welding, produce the mechanical arrangement of making the whole of an extremely fibrous description. The polishing secures a clean metal; indeed, so free from specks is the generality of barrels thus made, that it is scarcely possible to imagine clearer metal. When contrasted with the best of iron, by a powerful microscope, the closeness and density of grain is strongly apparent.

To such an extent has this been carried, that the author can produce specimens of a considerably increased specific gravity. The barrels made of this metal, in general, beat all tried against them, with this great advantage, that the finer the polish in the

interior the better they shoot, and continue longer free from lead. The only difficulty attending them is in the working; for boring, filing, &c. is more difficult, and greater care is required in seeing that they are not annealed,* when in the hands of the borer or filer; if so, they are considerably injured, though not to the same extent that barrels of a softer nature are liable to. We tested a great variety of bars, by drawing them asunder longitudinally by the testing machine, the average strength of the rod of 6-16ths broad by 5-16ths thick, 12 inches long, containing 1·40625 solid inches of iron, was equal to a tension of 11,200 lb. Thus furnishing a barrel with a thickness of metal in all parts of the arch equal, or 3-16ths of an inch thick, capable of bearing an internal pressure of 6,022 lbs. to the *inch of the tube*,

The generality of barrel makers spoil this metal by an attempt to obtain figure, for all extreme twistings in the rod depreciate the metal, by separating the fibres, and obtaining only an over-twisted rope. if we may borrow a simile, which is strictly disadvan-

* Dr. Ure falls into an error in describing the process of barrel boring, he says "the barrel is first properly annealed, and allowed to cool gradually," &c. The barrel-maker that would take such a proceeding with a barrel of ours should never do so to another. The Doctor ought to have pointed out the evil tendency of this. We never saw it done, and we doubt much whether he did, though we have heard of the practice, which induces us to notice it, but the Dr. describes it as a *necessary* proceeding.

tageous and useless: for the extreme density of the metal renders the figure difficult to be shown distinctly, as acid acts upon it but slightly, and never so as on metal where the fabrication is from two differently constructed carbonised materials.

Many conjectures have been advanced, and an endless discussion created, to account for the watering or "*Jowher*" in oriental sword blades, and genuine Damascus gun barrels. Any thing approaching the truth is seldom met with; though we think the explanation very simple. There is, as must be well known an immense variety of different qualities in both iron and steel; there is not uniformity of quality in two productions out of a hundred; the very ore, the coal, the presence of oxygen, the excess of it, all vary the quality of the material; the excess of carbon being more detrimental than a scarcity; for where carbon has once been, it leaves an indelible mark, and though extracted to as great an extent as practicable, it leaves a residue that possesses an affinity to absorb carbon again equal to the original quantity; thus, once make steel, and it will never, by any process yet known, be reconverted back to iron of the same nature it was originally. Mr. Mushet has given us the proportions of carbon *held in solution* by the various qualities of steel and iron, and the reader will find them in the note below.* It will follow,

* Iron, semi-steelfied, is made with charcoal,.. 1-150th part.
Soft cast steel, capable of welding with ditto, .. 1-120th do.

as a principle, indisputably, that the quantity of carbon contained in the metal—avoiding cast iron—will increase or decrease, and thus regulate the degree of hardness of the metals in question. A quantity of these being dissimilar in this point, mixed together, and run into a vessel in a state of fusion, when cold, filed, and polished, will show a variety as is the place they hold in the crystallised mass; work and twist this material in all the tortuous ways and shapes it is capable of, and you only twist the fibres of the different bodies in the same way, and when they come to be acted upon by acid or oxydisation, they still retain their relative positions, forming the watering or figure, as was the intention of the tortuous twisting. All the beautiful arrangements in Damascus figures are obtained in this way; metals containing more or less carbon will always produce this watering. To obtain a satisfactory proof, any person may case-harden a few pounds weight of stubs, and afterwards melt them in a crucible, and run them into a receiver; when

Cast steel, for common purposes, with charcoal	1-120th part.
Cast steel, requiring more hardness, with do. ..	1-90th do.
Steel, capable of standing a few blows, but quite unfit for drawing with ditto, ...	1-50th. do.
First approach to a steely granulated fracture, is from 1·50th to	1-40th do.
White cast iron, with charcoal, ...	1-25th do.
Mottled cast iron, with ditto, ...	1-20th do.
Carbonated cast iron	1-15th do.
And supercarbonated crude iron, ...	1-12th do.

these are worked down into the bar, or not, as he pleases, dress and apply a little sulphuric acid, and the peculiar situation the various stubs had taken, in the fluid-state, will be clearly discernible.

The original barrel-welders, the real Damascus iron workers, were like ours of the present day, not the most *conscientious* individuals, nor the most honourable. For strange,—but not more strange than true,—on examination of most real Damascus barrels to be met with, we find the iron must have been so valuable as to induce the workmen *to plate* or *veneer* the superior mixture over a body of the commonest iron; all large barrels are thus made, rifles especially. We presume the moderns *borrowed* the invention; it would be well if they made no more extensive use of it than on rifle barrels.

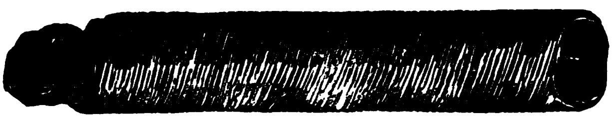
The modern method of making wire-twist and Damascus iron, being gradations from the same material, we shall describe them under one head from "The Gun:"—

"Alternate bars of iron and steel are placed on each other, in numbers of six each; they are then forged into one body or bar; after which, if for the making of wire-twist barrels, they are rolled down into rods of 3-8ths of an inch in breadth, and varying in thickness according to the size of the barrel for which they are wanted; if for Damascus, invariably 3-8ths of an inch square. When about to be twisted into spirals for barrels, care must be taken

that the edges of the steel and iron shall be outermost, so that, when the barrel is finished and browned, it shall have the appearance of being welded of pieces the size of wires, the whole length of the barrel. A portion of the rod, pickled in sulphuric acid, exhibits the following appearance :—

the bright parts being the steel, the other the iron.

" When about to be converted into Damascus, the rod is heated the whole length, and the two square ends put into the heads (one of which is a fixture) of a description of lathe, which is worked by a handle similar to a winch. It is then twisted like a rope, or, as Colonel Hawker says, wrung as wet clothes are, until it has from twelve to fourteen complete turns in the inch,



when it presents the above appearance. By this severe twisting, the rod of six feet is shortened to three, doubled in thickness, and made perfectly round. Three of these rods are then placed together, with the inclinations of the twists running in opposite directions ; they are then welded into

one, and rolled down into a rod eleven-sixteenths of an inch in breadth. Pickled in acid, to eat away the iron, it exhibits the following appearance :—

This iron has long been held in great esteem. It looks pretty ; but certainly does not possess either the strength or tenacity of wire-twist iron. It is well known that the strength of a rope may be destroyed by twisting it too much. So is it with this sort of iron. Iron is best when not twisted at all (we speak of the bar), for it resembles a piece of wood. The strands or fibres running parallel and firmly adhering, add strength to each other ; if you twist them you tear those fibres asunder, and they no longer support each other. So it is with iron.

"The objection made to the wire-twist is, that owing to the iron and steel being perfectly separate bodies, running through the whole thickness of the barrel, there is a difficulty in welding them perfectly, and, of course there is danger of breaking across at any trifling imperfection, or mis-weld· This objection is certainly well grounded, as many barrels break in the proving. The writer himself has seen a very strong barrel indeed broken across

the knee, without the slightest difficulty, while, to all appearance, it was perfectly sound. This is the reason why the manufacturers have ceased to make them, except for the American trade.

"It may be said, that the fibres in the Damascus, after being torn asunder, are new welded. True; but could you ever glue the fibres of a piece of wood (twisted in the same way) together again, to make them as strong as before? No; cut several pieces of wood across the grain, and glue them together, you would not expect them, though equal in substance with a piece in which the grains run lengthways, to be of equal strength. In short, we hold a Damascus to be little superior to a common barrel, where the fibres run parallel to the bore."

All the varieties of figured barrels are but modifications of Damascus. The most endless variety possible may be attained; a figure with the carbonised material, showing only the ends or edges of the various laminæ, or portions of the face of that lamina, may with equal facility be obtained, if the patience of the artist be in proportion. It would be a never-ending task, a subject for many volumes, to endeavour to describe a tithe of the varieties that might be made, and have been.

The Belgians are very expert at this sort of ornamental work. The very minute Damascus figure they frequently produce, is admirable, if beauty alone were the advantage sought in a gun barrel. They

use thirty-two alternate bars of steel and iron, and roll them into a sheet of 3-16ths thick, and then slit them by a machine into square rods; these are twisted in the way just described, but to such an extreme as to resemble the threads of a very fine screw, six of these are welded into one (instead of three as with us.) The figure is so extremely fine as to appear not to be larger than the finest needle. We have seen barrels made in Liege, superior in minute figure to any real Damascus barrel or sword either. Our workmen here, say the steel is better, which we are inclined to think is true: it is a branch of the gun manufacture they have long excelled in. The very best "Damascene" workers are to be found at "La Chafortaine," a few miles from Liege, where they dwell in as beautiful a dell as fancy could wish, with a powerful hill-stream working their boring and grinding-mills, enabling them to send their barrels into Liege, ready for the filer. We have spent considerable time and taken great trouble to produce in Birmingham, iron equally good, and have succeeded, but unfortunately, Englishmen are so extravagant in their ideas of value, as to render the constant manufacture of this iron here, a losing speculation, but it can be obtained from Belgium now, under the amended tariff, at ten per cent. on the value. It can be purchased there ready for barrel making at a "franc" per pound, and cheap it is at that price, two and half francs would not purchase it here.

That it is incompatible with goodness, we can and shall clearly prove; for experiment, with the testing machine, shows a rod of wire-twist 3-8ths square, containing 1·6875 solid inches, as equal to a tension of 11,200lbs. A rod, when converted into Damascus of 11-16ths of an inch in breadth, by 4-16ths in thickness, containing 2·625 solid inches, was only equal to 8,960lbs, being thus a clear loss of full thirty-five per cent. And when welded into barrels of the dimensions described, the relative internal strength of each is 5,019½lbs. and 3,292lbs. *to the inch of tube*. This constitutes a great difference, were that all, but unfortunately it is not.

In the preceding chapter we noted the fact, that all sorts of iron lose a portion of their strength by being heated or softened; but we found Damascus suffered more than any other sort of iron excepting the common kinds. For instance, the bar of wire-twist would bear in the state it came from the rolling mill, 11,200lbs., but after softening, it would only bear 10,180lbs., being a diminution of 10 per cent. A bar of Damascus, suspending a weight of 8,940lbs., when annealed, 7,840lbs. was the measure of its strength, being a falling off of 12½ per cent. Thus, we trust we have clearly shown, that whatever other quality Damascus possesses, strength is not one of its properties. It must not, however, be supposed that the above weight indicates its greatest strength; on the contrary, its strength can be

increased full 22½ per cent. by cold hammering. Still, however, it will only hold its relative position to other irons with respect to strength, for they are all capable of having their strength increased by the same process.

Damascus barrels have fallen much into disuse, being rarely seen except as pistol barrels,* which, together with a great quantity of *counterfeits* are made for the South and North American trades, in the shape of double and single guns of a flashy appearance—all invariably *veneered* or *plated* with ribbons of this ornamental iron. We shall dismiss this subject, after remarking, that certainly a very handsome barrel may be made after this pinciple, if too much twisting be avoided. It has been seen that the rods are twisted until there is fourteen turns in the inch of length, an excess productive of the effect mentioned, while, had there been but two turns, a large proportion of strength, if not all, would have been retained; while one turn, under the same circumstances, would very likely be highly beneficial. Indeed we have found it to be so, one twist binds the interior strands, as the outer the interior in a rope, and thus adds strength, showing that there is a medium in all things.

The use of old horse shoe nails is of a date nearly coeval with the use of small fire-arms. These nails

* The London makers are again using them extensively, which is certainly no proof of their judgment.

are made from rod iron of the best description, and the hammering cold, or tempering the nail, so benefits and condenses the iron as to improve it greatly. The method in use until a late period, was to fill and force into an iron hoop, of six or seven inches diameter, as many stubs as it would contain,—weld the whole, and draw them down to a bar of such dimensions as might be required. Modern improvement, however, has shown the advantage of cleansing the stubs perfectly by a revolving drum, and then fusing and gathering them into a *bloom* on the bed of an air furnace, and thus a body of from 40 to 50lbs of melting iron can be obtained at one heat, a matter of economy and necessity, where large quantities are required, besides possessing the superior advantage of having the whole mass equally heated, which cannot be done by the old hoop method, as the surface must be frequently burnt before the interior is at all in a welding state. Experience taught the late Mr. Adams and his brother George,—who still manufacture some of the best gun iron in the world,—that the stub iron alone was insufficient, for even then, (25 years ago) a knowledge of the absurdity of imagining no barrels were or could be good without being soft, was understood by them and acted upon. They introduced at first one-fourth of steel to three of stubs, this having been found highly advantageous, the prejudices of the gun-makers were gradually overcome or left in

abeyance, from ignorance of the introduction, for, it is a fact, as late as 1835, when we issued our former work, men who had been all their lives *gun-makers* (by courtesy) actually refused to believe that any steel was in the composition of best barrels at all, and several that we know perfectly well, ordered the factors with whom they dealt to be sure " they sent them no barrels with steel in, as they did not wish their customers' hand to be blown off." A very creditable wish certainly, had they not by so doing taken the readiest way to cause such a result; as factors are men who neither know nor care any thing about the peculiar virtues of the articles they sell, if they but gain a few shillings more. Charcoal iron, has, up to this day, been the only stub twist barrels they (and we believe two-thirds of the provincial makers also) have ever been served with; reason with these men, and they will snappishly tell you, " we pay the best price, and we ought to have the best, we don't see that our neighbours have any better;" and thus you vainly endeavour "*to wash an Ethiopian white.*" Only a short while ago, calling upon one of the first provincial makers in the kingdom, the subject of barrels was adverted to—" An excellent work that of yours, I dare say; but, sir, you have done a deal of harm, it is wrong to let gentlemen know too much, they give you far too much trouble, they get too know-

ing." These, and such like observations, are the only thanks we ever received from the generality of the gun trade; there are some enlightened men truly, who, understanding the subject, have appreciated our motives, but by far the greater proportion have done the reverse, asserting "we had told them nothing but what they knew before."

The mixture of a portion of steel with the stubs having clearly shown an improvement, an increased proportion has been adopted by various makers. We have had as high as three-fourths of steel to one of iron, and where proper attention is paid to the clipping of the steel to pieces, corresponding with the stubs, and properly mixing the whole, welding and forging by the heavy hammer, reducing by a tilt and rolling down to the smallest description of rod, a most excellent, tenacious, and dense body of iron is obtained; while, by cutting into lengths of six inches, bundling a number together, and re-welding them into a bar, an increased density and tenacity is gained by an increase in quantity, and an elongation of the fibrous system; rendering any description of barrel, of this iron, if made with a moderate degree of care and attention, considerably more strong than any explosive fluid ever yet compounded could burst, under any circumstances bordering on *fair play*.

The great advantage derived from welding on the bed of an air furnace, arises from an absence of the

minute portions of the charcoal of either wood or coal, as the case may be. These very minute portions are imbedded in the midst of the metal in every part in millions, and are enclosed in cells of their own dimensions originally, but are drawn out with the fibres to an indefinite extent, forming a system of tubes that may be compared to the capillary system in trees, and making the iron of a spungy compressible nature. It is the absence of this that gives part of the superiority to steel as now made, and already described, for gun barrels, and the existence of a portion to the inferiority of all other irons, one below the other. In chemical analysis of iron, a large portion of crude coal or wood-charcoal is found, according to the use of either during the manufacture. This is not of course given as so much carbon in the result, though the injury is equally detrimental, as an excess of carbon is to the goodness of the metal, for it renders the whole porous, open and liable to attract moisture, and induce oxydation; for it must be kept prominently in view, and clearly comprehended, that the denser the body of metal, the less the liability to oxydise, or in other words *rust;* and here is the one great preservative principle in good iron, "it is the fibre of dense cocoa wood, compared with that of willow or saugh" In all situations, for all purposes, where iron is liable to sudden changes of either heat or cold, wet or dry, the very best of iron should be

obtained, as it will be less affected by the changes, and amply repay by its durability the extra cost in the first instance.

The very extensive round of experiments we have lately submitted mixtures of this nature to, clearly establish all the conclusions we have formed on these points. The strength of the mixture, three parts steel to one of stubs, gives a resistance in the rod of 6-16ths broad by 5-16ths thick, and 12 inches long, containing 1·40265 solid inches, equal to 10,295lbs. before separating, and thus being equal in a barrel of the dimensions before mentioned, to an internal pressure of 5,555lbs. to the inch of tube. The proportions mentioned in the "The Gun" are 25lbs. of stubs to 15lbs. of steel, and the strength of this mixture in the rod is equal to a tension of 8960lbs., and the barrel capable of restraining a pressure internally of 4,818lbs., making full 15 per cent. dissimilarity in favour of the larger proportion of steel; but all experience points to the great advantage steel, properly worked, possesses over iron alone. A great good can be secured by condensing iron by hammer-hardening, greater than we have shown steel is capable of receiving additionally, already having it naturally without the necessity of artificial means to obtain it. Nor is it so liable to depreciation in the hands of an inexperienced artisan, as the degree of expansion is not more, in the large proportion of steel mixture, than a loss of

strength equal to $4\frac{1}{2}$ per cent. by heating and cooling gradually. The loss in the mixture containing less steel is $7\frac{1}{2}$ per cent. The specific gravity of the two is in proportion.

The frequent welding and re-rolling of iron is of the most beneficial tendency, the elongation of the fibres being highly advantageous; for a fibrous piece of iron may be compared to a wire rope, the more strands the greater tenacity; the smaller the strands, even up to a proximity of fineness to the human hair, the greater the weight they will bear in tension. One large wire which, when single, will suspend 500lbs., will, when drawn down to six small ones, suspend 600lbs., and so on, to the greatest extreme. Another great advantage received by the repeated reworking of iron, is obtaining an increased density; for when this is secured to a certain extent, you have closed in proportion the pores of the metal, and in this state it is not liable to that degree of expansion or contraction, that fluctuation in strength arising from softening the iron. Nor can you gain in it, save to a limited extent, any improvement by hammering,—hammer-hardening, for instance,—simply because it is already improved to the utmost extent we are at present acquainted with. How wonderfully beneficial to mankind is this beautiful arrangement of the metallic fibrous system; without it what could we do? our manufactures would be confined to simple castings, or

crystallizations, possessed merely of strength in proportion to the cohesive nature of the metal. Where would be all the wonderful springs, whose fineness vies with the silken fibre? Of what could they be constructed? Almighty gold would not suffice, nor silver, though each, in their place, possesses wonderful properties. Gold and silver may both be spread in thinnest coats over space incredible; on the gilded bauble, or, still thinner, on the plated porcelain. But iron alone is to the arts, the "*summum bonum*," for which there is no substitute, it is the "*sine quâ non*" of practical science.

The improvement in the manufacture of a very superior iron may, we believe, be placed to the credit of the gunmaking profession exclusively, no body or class of men having ever yet deemed it worth their trouble to endeavour to obtain anything of a better description *than bar iron, suitable to make steel from*. Mr. Mushet, from whose work we have already quoted, has evidently been more intimately acquainted with the routine of iron manufacturing than any other person we ever met with or read of, he understands the question perfectly, yet says nothing, nor seems to care for anything further *than a suitable steel iron*.

How many and how fearful have been the explosions by all powerful steam since the period of its introduction. How many weeping widows, and how many fatherless children have had to mourn its

effects; and what has human nature done? what have the wonderful energies of the present wonderful race of scientific men accomplished to stay this annual slaughter? Comparatively little; a most fertile discovery of mysterious causes where none exist. It reminds us of our first lesson in coursing—" If you want to find a hare, young man," said the keeper, " look at your feet, you will not find her at a distance." So it is with the state of knowledge on steam boiler explosions; if you want to find the cause, look " at your feet," do not endeavour to envelope in mystery, what you may find in simple and natural causes. We may just premise, that we were professionally engaged to inspect the effects, with a hope of finding the cause, or thirty-four cases of explosion, where the sacrifice of human life would be above an average of two each, or nearly one hundred, and never yet have we found one single case which we could clearly demonstrate to have been either caused solely by neglect of the superintendent, or sheer ignorance on the part of the engineer constructing the arrangement of boilers. For every accident may *sweepingly be said* to be occasioned by a want of space of escape, a too small valve in the first instance, and in the second a villainous construction of what is called iron boiler plate, a concentration of the veriest rubbish, under the name of wrought iron, ever gathered together. For this have we, good reader, drawn your attention aside for

a few moments. We first started with iron, and the improvement of boiler-iron may detain us slightly, if by the delay any good can be accomplished. For an inconsiderable increase of outlay, a boiler might be rendered doubly safe to what it is at present, by simply using moderate caution in the selection of scrap iron, a perfect cleansing of that scrap, and fusing the bloom on the bed of an air furnace. The great advantage would be that you get a stronger, a much denser, and consequently a much better metal; nor is this all the advantage; you might use a very much thinner plate, and yet an equally strong plate, and science will tell you that steam would be easier generated, as heat is more rapidly conducted. While on the subject of iron, we shall, if the reader please, diverge a little further. Iron is a peculiar body in many ways, and it is essentially necessary that artificers in it should be men of keen discernment. The subject may have obtained the attention of many besides ourselves, but as we have never yet seen it noticed, we shall do so here. In the welding of all large bodies of iron such as machinery, shafts, anchors, and shanks, where there is considerable substance of iron to be acted upon in a melting state, a complete separation, longitudinally, of the interior bars takes place, and the generality of shafts, of this description, are but surrounded by a welded case of iron. Arising from the outer elongation having broken the interior bars, it becomes a certainty if

the effect of the blow on the interior is not in proportion, the fibres internally are elongated by their adhesion to the outer, and thus lose cohesion; separating in this state from a want of sufficient tritulation. The necessity of suiting the blow to the mass, becomes thus apparent, and points the remedy.

There is a very handsome description of barrel-iron made, generally. termed "Stub-Damascus." The method of preparing it, is of late considerably altered; a quantity of old files are hardened by being heated red hot, and immersed in water, broken in pieces by a hammer, and afterwards pounded in a mortar until the pieces do not exceed in size a corn of number five shot; a proportion of 15lb of these to 25lb of stubs, is fused together on the bed of an air furnace, beaten down, and rolled into rods.—The rod of 3-8ths of an inch square, is then twisted like a rope, precisely in the same way as the Damascus; the effect of this winding, is to give a beautiful mottle to the barrel, which will be found depicted in plate No. 3.

Another mixture, represented in No. 2 plate, was first made by Mr. Wiswould, of Birmingham; it is a compound, as far as as we have been able to ascertain, of three of steel to one of iron, intimately blended and intermixed, and twisted as just described; it is a most beautifully clean, and dense iron, but the extreme twisting is to it, as to all,

highly injurious and prejudicial. The twisting is similar to the Damascus, only that two twisted rods are welded together instead of three, but with the twist of the strands running in opposite angles, as depicted in the wood-cut below.

The degree of strength is similar to the stub, and other Damascus ; it being quite certain, that be the composition what it may, this rending of the cohesive attachment by twisting, will eventually equalise the strength of the whole.

The use and introduction of charcoal-iron, is one of the *funguses* reared and supported by the hot bed of competition and deception combined, a wish to foist on the purchaser a counterfeit for the real "*Simon Pure,*" a concatenation of pretence and appearance without reality. Had we but the gift to invent abusive terms, we would heap them as high as Olympus upon this compound. We would not give shop-room to the best barrels ever made from it, as *we hate a scoundrel and a hypocrite*. This iron is both.

The compound consists principally of cuttings of sheet iron, of which there is an endless supply

in the neighbourhood of Birmingham, from punchings and from one trash and another; after properly cleaning, a quantity is put into a charcoal furnace and melted, cast into a pig, and forged down to a bar and rolled into rods, corresponding with the size of stub twist, which it is intended to represent. The action of the charcoal communicates to it a portion of carbon, which, when stained in a certain way, gives an appearance much resembling that beautiful metal just mentioned, but if all and every means imagined by the inventive faculty of man were used with it, it would not make it really good iron. An iron which is technically termed "Weak," can never be made a strong bodied iron, an "iron suitable to make steel from," to repeat a former quotation; the original iron from which these scraps generally come, is wanted to be a "weak" iron, for, the facility with which it can be rolled into plates as a strong fibrous iron is not necessary. I hope the reader will take the advice of "Edward Davies," a gentlemen who wrote in 1619, who says "He that loves the safetie of his own person, and delighteth in the goodness and beautie of a piece, let him always make choice of one that is double breeched, and if possible, a Mylan piece, for they be of tough and perfect temper, light, square, and bigge of breech, and very strong where the powder doth lie, and where the violent force of the fire doth consist, and notwithstanding thinne at the end, our

English pieces approach very neare unto them in beautie and goodness, (their heaviness only excepted) so that they be made of purpose, and not one of these common sale pieces, with round barrels, whereunto a beaten souldier will have great respect and choose rather to pay double money for a good piece, than to spare his purse and endanger himself." Truly the fraternity have always, we find, been of doubtful honesty, always making "sale pieces." We shall again quote from "the Gun"—

"This converted iron, however, will not endure the test of browning by smoke, or, more properly, flame, as the oxygen invariably destroys the appearance of steel in twelve hours after its application. By the old method of staining, it would be as impossible for any man who was not a judge, to point out the real from the counterfeit, as to discern a copy executed by a clever artist from an original painting by one of the old masters."

Deception is ever fertile in expedients, and an excellent invention was soon found out to imitate the advantage possessed by the "*smoke brown*," which they obtain by first browning or staining the barrels very dark. A weak solution of muriatic acid, or spirits of salt, is applied very lightly with a spunge, and the colour is extracted from those portions of the iron left more prominent, by the excessive *pickling* they are subjected to before staining,

they are then immediately dried, scalded with hot water, and the stain is complete, a most ingenious imitation. We wonder the parties did not take a *patent for the discovery.*

"Its greatest strength appears to be as follows: 7-16th of an inch broad, and 5-16ths thick, solid contents 1·40635 inches, will bear a weight of 10,080 pounds; so that if our calculations are correct, it will bear only a pressure of 4,526 pounds in the tube. The loss of strength by heating or softening, being full 10 per cent.

"We have already stated that this iron is very much used in consequence of its cheapness, its cost being only fourpence per pound, while stub twist costs fivepence. It is also easily worked, being considerably softer than any of the above-described irons.

"It may be asked, why so much inferior iron is used, when the difference in the price between the good and the bad is only a penny per pound? The reason is this:—If a barrel filer receive an order for a pair of barrels, having probably deceived his customer before, or, at any rate, knowing that he can deceive him without running any risk of detection, he sends to the welder sufficient charcoal-iron to forge these barrels. Should the quantity amount to ten pounds, he, of course, saves tenpence. The welder receives two shillings less for welding this description of iron, than for welding stub-twist, so

that here is already a saving of 2s. 10d. At the boring-mill, and the grinding-mill, the charge is also proportionate; the wages of the journeymen are less, so that by imposing on his customer one pair of barrels manufactured of this sort of iron instead of the real stub twist, he pockets a clear fraudulent gain of above 9s.; and should he manufacture one hundred pair of such barrels in the year, it would make at the end no small item in the year's account of profit.

"Thus it is with all description of barrels. The charge for making, by each workman, in the various stages of the manufacture, is according to the quality of each pair of barrels. The saving, then, to the man who makes one hundred pair of barrels in the year, though it be but a farthing in the pound of iron, amounts to a considerable sum. This fraudulent gain of more than 5s. on a pair of pretended stub barrels, is what is called in Birmingham, "a nip—biting the yokels"—a reward for ingenious knavery. But when they receive orders from what are called general factors, who very kindly supply their country friends at a moderate commission of 40 to 50 per cent., these gentry take care to lap up the cream; for we know from facts that the barrel filer has sometimes scarcely five per cent. for his trouble of overlooking. One consequence naturally results from this, that every species of roguery and deception will be resorted to, in order to indemnify

such people for their labour and trouble. At the present time, we know it to be a fact, that there are hundreds of guns made in Birmingham, the barrels of which, in some instances, never enter the proof-house, as sixpence per barrel, the cost of proof, is a great temptation! Besides, a great number of barrels declared "wasters," such as repeatedly bulging in the proof, being full of flaws, having holes in the sides, or some other fault sufficient to condemn them in the eyes of a moderately conscientious barrel-maker, are bought by men who live by this species of fraud, and are repaired with such neatness, putting in pieces artfully, beating down swellings or bulges, and then forging the proof mark; and, last of all,—mark!—as if to crown their duplicity and villany, they fit them up, send them to the engraver when ready for that process, and by having the names of some living or defunct London gun-maker of respectability engraved upon them, palm them off, upon some hardwareman, as a good article."

Threepenny skelp iron is made from an inferior quality of scrap to that from which charcoal iron is made; but unlike it, there is no pretension of quality. Its inferiority is not denied; it is poor in quality, and suits parties who cannot buy better. The method of preparing is by an air furnace, forge, tilt and rolling mill, as before described. The greatest strength of a bar 11-16ths broad, by 3-16ths

thick, containing 1·5468 solid inches, is 7840 lbs., or equal to an internal pressure of 3841 lbs. to the inch of tube. One particular fact attaches to all inferior irons—the greater the mass acted upon by the rollers the greater the variation of strength,—arising entirely from the increased spunginess of the metal, and greater expansibility. For instance a rod one-sixteenth thicker, is 15 per cent. weaker in proportion, and so on to the greatest extent. But on the other hand, it is capable of recovering a great increase of strength by cold hammering, greater than better irons. A considerable quantity of this iron is sold to engineers, and used in the construction of locomotive and other engines, the price and uniformity of texture in grain fitting it for that purpose.

"Twopenny" or "Wednesbury skelp" is nearly too inferior, is almost too bad, to make an article, which may endanger the limbs of our fellow-creatures. It is made of an inferior scrap to the former, in precisely the same manner. In point of strength it is still lower. The bar is generally 1 and 1-16th inches in breadth, by 3-16ths thick, the solid contents 2 inches and 25-64ths, and will bear a weight of 7,840 pounds, and consequently the strength will be 2,840 pounds to the inch of tube.

"This is a great falling off in strength. We would ask any one who values the safety of his hand, if he would like to risk it, by using a gun made of iron,

possessing so low a degree of strength, as compared to the force of the charge it has to bear? Let him recollect that the force of the charge may be increased by a variety of circumstances. The pressure of a certain quantity of powder, on which a certain weight of shot is placed, is so many pounds to the inch. If you double that weight of shot, you nearly double the pressure. In estimating the force of pressure, the opposing friction is also to be taken into account. If the gun be allowed to get very foul, then friction is increased, and of course, a still greater pressure is thrown on the tube of the barrel. All these circumstances being taken into consideration, we repeat, that *no barrel is safe, whose power of resistance is not more than double the strength of a charge of sufficient force for general shooting.* Every bad gun should be thrown aside as unsafe, or used with the greatest caution." Bad and inferior as guns are made from the foregoing material; not many years have elapsed since they were thought good enough for military arms.

"The composition of "sham damn skelp" is the most inferior scrap. We should not have mentioned this description of iron had we not seen hundreds of barrels made of it, and did we not consider them perfectly unfitted for the use of any person who cares at all for his safety. We have met with them under the dignified name of twisted barrels, more frequently under that of what their name denotes.

Guns that are fitted up at from twelve shillings to a pound, are not patent breeched, but are made to appear so by staining them generally blue, and by having a couple of bands to imitate platina, across the squares. A projecting part is welded on to the side, into which the nipple is inserted, and the lock joints neatly under it. Certainly, many of them are good imitations, but once take the barrel out of the stock and the deception is instantly apparent, as it is rarely carried further than the outside.

"The beautiful way in which the barrels are painted to imitate fine twist, catches the eye of the simple countryman, who is generally the dupe of this artifice; and the persuasive eloquence of the itinerant hardwareman, seldom fails to extract from the pocket of his unsuspecting purchaser sometimes thirty or forty shillings of his hard earnings for what the knavish trickster rarely pays more for than fifteen shillings. Many are the anathemas vented, when the deception is found out by some one more knowing than the poor dupe, who not unfrequently purchases his experience at the expense of a finger or a hand. It is astonishing what a quantity of this rubbish is disposed of by the wretches who infest market towns and villages with guns for sale.

"But the English peasant is not the only dupe of this species of knavery. Thousands of these guns are sent monthly to the United States, to the Brazils, and South America; where they are disposed

of, among the poor Indians, in exchange for skins and furs. They are all understood to be proved. How many are so we cannot tell; but that some of them are not, there can be no doubt. It may be said, that the manufacture of these guns is a great support to the gun-trade of Birmingham. It is, certainly; but would not the interest of the trade be advanced, if we were to manufacture none of so inferior a quality? "But then we could not compete with our rivals in Germany and the Netherlands." True; we should not be their rivals in the production of rubbish, but the superiority of our guns would then command a market. It is by sending to the market an article no better than theirs, that has begun to make foreigners indifferent about the purchase of ours, as they say "the English guns are no better than the Belgian or German, we may as well purchase one as the other." The truth of this remark is illustrated by the state of the African trade. The base kind of articles we supplied them with, some years ago, has produced a distrust of our manufacture, which will not easily be removed. In the course of a few years, no doubt, a similar distrust will be engendered by the same cause, in the minds of our present customers. It is much to be deplored that the consideration of present gain, should render men blind to the consequences of their conduct, and lead them to prefer the immediate gratification of their avarice, to the future welfare of themselves and country.

"The method we suggested of testing all irons in the bar, would go far to destroy their trade. We have not thought it worth while to test this iron. Twist barrels are made of it. Should the reader meet with a double gun so made, let him avoid it: it is unsafe, unless it be so heavy as to be unmanageable.

"A great many long rifle barrels are made of this iron, principally for the American trade; but from their immense weight, and the small charge of powder required, there does not exist the same danger.

"Fowling-piece barrels made of it may be generally recognised by the smallness of the bore and the thickness of metal. As the charge in proving is very small when compared with charges for proving guns of a wider calibre, we need not be surprised that many of those that are proved stand proof."*

* Mr. Wilkinson, in his "Engines of War," has the following passage. Speaking of his article on the Manufacture of Fire Arms, &c. he says, "It may not be improper in this place to notice, that the greater part of the preceding papers, illustrated by numerous specimens and experiments, was read by me in the form of lectures, at the Royal institution and Society of Arts, in 1832, and written the year previous; but in 1835 a book was published called 'The Gun,' containing information respecting the *manufacture of fire arms* only. The author, Mr. Greener, has since assured me he was not aware, when he published his book, that any one had preceded him on the same subject." Mr. Wilkinson wrote to us soon after the date alluded to, in which he said, he could confirm our statements from

"Swaff iron forging" is a profitable branch of forging carried on in Birmingham under the above title. It is a metal which is composed of iron and steel filings, chippings of breeches, pieces and cuttings of the ends of the screws, lock plates, cocks, and the rough borings of barrels, and all other small scraps found in gun-makers' and other work-shops. These are collected by the boys in each shop, and when they have accumulated, are sold to the "swaff-forger," and the proceeds are considered as drinking

having read several lectures on the same subject, &c.; as a matter of course, he was told we were not aware the same subject had been taken up by any other person. He has now published what he would so pompously insinuate we had borrowed. To those readers who have seen both the books in question, we need not say anything, but as many may have seen only one side, we may say, strictly, Mr. Wilkinson details, in the most imperfect manner, the process of barrel iron making, and barrel welding, as he saw it. We say imperfectly—speaking of forming the spiral of barrels, he says, "one of these pieces is made *red hot*, and twisted into a spiral form, by placing one end in the prong of an iron rod which passes through a frame, and is turned by a handle, the riband being prevented going round without twisting, by means of an iron bar placed parallel to the revolving rod." He would be a useless tool indeed, that would require the rod of iron to be heated to form a spiral; it may be done, but it will be a villainous piece of iron indeed to require it. But, in short, the whole article contains, not one experiment, not one fact, but which is a matter of detail. To compare the one article to the other, is *proof* indeed "that parents feel greater affection for their own children than those of others," to quote himself. We have already shown that Mr. Wilkinson is wrong in many of his conclusions, but in none can he be more so than imagining we had borrowed from him. Impossible! he has nothing to lend, and of course nothing worth borrowing.

money. By him they are forged into bars of iron, attaching them together by immersing them in diluted sulphuric acid, and after draining it from them again, and placing a large iron pan full in a hot situation, they become cemented together by the action of the oxide. The compound is then taken from the pan by turning it upside down, put into an air furnace, heated to a welding heat, removed and beaten into a bar, by three men with light hammers beating it as quickly as they do in welding a gun barrel. The iron is sold to the gun-work forgers, for the forging of the patent breeches, lock plates, furniture, and other parts of the gun they think worthy of good iron; but since cheapness has become so much the order of the day, the use of this iron is certainly confined to the forging of best gun-work, cast iron being thought quite good enough for common gun-work.

CHAPTER V.

BARREL-WELDING.

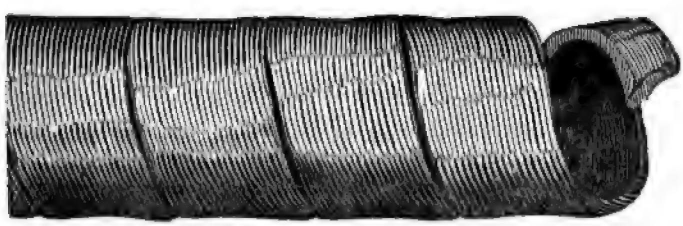
We shall, in this chapter, briefly describe the process of the manufacture of guns, of all qualities, commencing with barrel-welding, which, in importance, is inferior only to the *quality of iron* in the routine of good gun-making.

Birmingham, and the surrounding districts, are the only places in England where barrel-welding is practised. The superior advantage possessed, in having coal nearly, if not entirely, free from the presence of the sulphuret of iron, which has always

been found a considerable hindrance to the obtainment of clear and good barrels, is greatly in their favour. For a considerable period, individuals in London contended with the Warwickshire welders, but being an unequal contest, it ended in favour of the provincialists; a matter to be regretted, as there can be no doubt, greater reliance could be placed on the material of the London productions; but; one considerable drawback existed with the latter, they made only one sort of barrel, and that the best, now it is requisite to have a fire fitted for the purpose of welding best barrels, tempered as it were, and this can only be effected by some hours using, which is generally done in the production of a number of very inferior barrels; the London people made no common guns, they needed no inferior barrels, they welded their best barrels in a raw untempered fire, and hence arose the admitted inferiority of their work. The late Mr. Fullard struggled long and hard in the competition, but with his death, barrel-welding ceased in the metropolis. For it would have been highly imprudent, and unprofitable, for any one to have entered upon such a speculation; there being no certainty of success, but truly of the contrary. The Birmingham barrel-welders are wonderfully clever smiths, they cannot be excelled; and if *ridden with a curb*, they do well, but no opportunity must be given them, or to a certainty they will "bolt" from the true path.

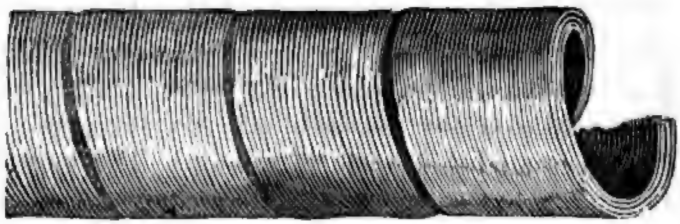
"The rods are twisted by means of two iron bars, the one fixed, the other loose. In the latter there is a prong or notch to receive one end. When inserted, the bar is turned by a handle. The fixed bar preventing the rod from going round, it is bent and twisted over the moveable rod like the pieces of leather round the handle of a whip. The loose bar is unshipped—the spiral knocked off, and the same process recommenced with another rod. The length of all the spirals depends on the breadth of the rod; for instance, the stub-twist has sixteen circles in six inches long; a rod five feet will make a spiral of only seven inches, while iron, of an inch in breadth, will make a spiral of as many inches long as there are twists, and hence the reason best barrels have more joinings than common ones of equal length."

The Damascus being rolled into rods of 11-16ths broad, form a spiral with the appearance shown in the accompanying wood cut.

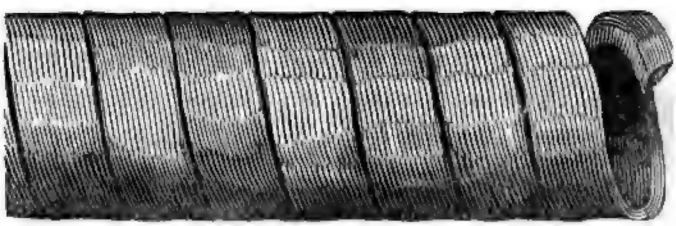


The fancy steel barrels and others, where the rod is formed of more than one piece, such as the

stub Damascus, &c., &c., &c., is of rather greater breadth, like the representation below.

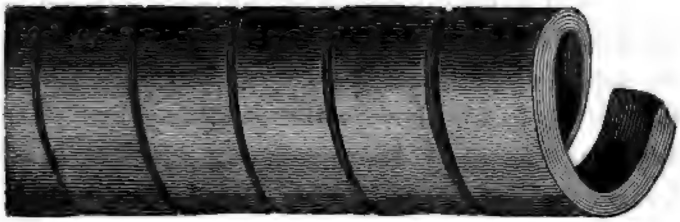


The iron made from stubs, and steel, and plain fibrous steel, is invariably rolled down into rods of 6-16ths broad, forming a spiral, as below.



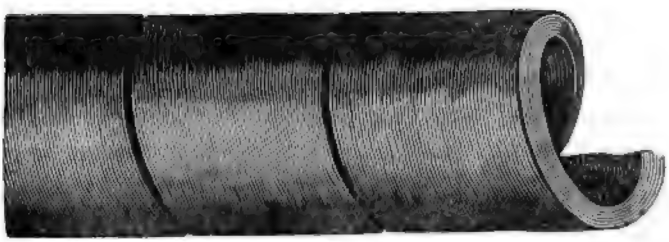
A proper attention to the fineness of the spiral will always enable an amateur to detect any attempt at imposition.

The spiral formed from the rod of charcoal iron has a somewhat different appearance, but in cases where it is intended to supply the place of the real stub iron it is of corresponding dimensions, and in general very difficult to detect without a very intimate knowledge indeed of the nature of iron. When honestly intended, it forms a similar spiral to the accompanying one.

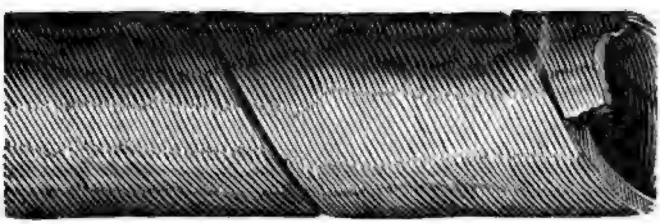


The wideness of the twist, or the angular direction of the fibres, will enable the most uninitiated to recognise a barrel made from threepenny skelp iron, the very few welds required, is one cause of the cheapness of barrels made from it. Judgment may be formed of it by the representation following.

Two-penny or *Wedgebury* skelp is coarser in the spiral still, and running so angular as not to be very difficult *to tell his breeding.*



All iron formed in spirals becomes, as a matter of certainty, *twist barrels;* the parties whose use they are intended for, seldom know or care for anything further than having a twist barrel'd gun. The advantage of *sham damn* iron being twisted is all imaginary, and if used at all, it may be twisted; but those who value their safety would consult it best, by tying a large stone to such a gun and sinking it *fathoms deep*, but to satisfy those who may fancy such things, we give a wood cut of the spiral ready for welding.



The spirals being thus formed, the welders commence their day's work. The batch consists "of a foreman, one on whose skill all depends, and two subordinates, whose duty it is to blow the bellows, strike," &c., &c.

"They proceed to weld probably a dozen long common barrels for the American trade, which are generally composed of the inferior iron, mentioned before, rolled into two lengths of different thicknesses. These skelps are heated, and beaten on a groove until they form a tube half closed. They

are then heated again, and closed with one edge over-lapping the other, as a brazier would over-lap the edge of a tin pipe, for boys to blow peas with. Having got the two lengths of the whole dozen turned into tubes, they proceed to weld the longer length or fore part, by heating it sufficiently for four or five inches, introducing a mandril of the required size to suit the bore wanted, and then beating it into a perfect tube, in a groove, on the anvil, of corresponding diameter; heating it again and again, until the joint is closed the whole length. They then proceed with the other eleven fore parts, and advance the whole, to that stage before welding on the breech lengths, which are now partially heated by laying on the outskirts of the fire, to be in readiness: they are then closed the same as the fore parts. The end, when about to be jointed, is opened a little on the peam of the anvil, to admit a portion of the end of the fore part, which is introduced as soon as both are in a welding state: the mandril is then introduced, and the joint is perfected in less time than we have occupied in the description. The other part of the tube is closed, and the barrel is then complete. If, however, the breech part is to be square or octagon shaped, it is not welded in a groove, but on a plain surface."

Competition has reduced this department of the trade to a low ebb, thousands of these sort of barrels are now annually welded for about eightpence each,

and if to this we add one penny farthing per pound for six pounds of iron, we get a forged gun barrel for one shilling and threepence half-penny. This is certainly a poor remuneration for *sweating* over a furnace containing from two to three hundred weight of intensely heated coal. The introduction of welding by the rolling mill, will eventually supersede this arrangement, a matter to be regretted only on the score of answering the purpose of preparing the fire for best welding.

"They now commence the welding of twist barrels. Spirals that are intended for the breech end, are heated to a welding heat for about three inches, removed from the fire, and jumped close by striking the end against the anvil. Again they are heated, and again jumped, to ensure the perfect welding. They are then beaten lightly in a groove, to make them round. The neatest part of the process consists in the joining of the points of the two rods, so as to make the barrel appear as if it had been twisted out of one rod. The ends of the two rods are a little detached, brought from the fire, and applied to each other. A gentle tap is then given, and the union is perfect in an instant. The rapid dexterity with which this is accomplished, ought to be seen to be duly appreciated. This trouble is only taken with the best barrels. In the manufacture of barrels of an inferior description, the ends of the rods are cut in a sloping direction, which, when welded to-

gether, become quite square at the part where the pieces are joined. In a finished barrel the points of junction are easily recognised. By tracing the twist, a confusion will be found to exist for about an eighth of an inch every six or seven inches. From this appearance you may conclude that, for a barrel so joined, the welder had not the best price. Having joined the whole of the spirals, three inches are again heated to a welding heat, the mandril is introduced, and the tube hammered, in a groove, to the size required. This operation is repeated until the whole length is finished. This being done, then follows hammer-hardening, that is, beating the barrel in a groove in the cold state, with light hammers, for the space of half an hour. This is a most important part of the process. It closes the pores, condenses the texture of the metal, compresses a greater substance into less bounds, increases greatly the strength of the barrel, and renders it more elastic. This, however, is seldom done, unless specially requested, and then a gratuity is, of course, expected, either in money or beer, and we believe a few pots of the blood of Sir John Barleycorn, will infuse more strength into your barrels than you could purchase for ten times the amount in money, as they have the effect of making the hammer descend with increased velocity."

"If all barrels were hardened in this manner, their shooting powers would be increased, and they would

not be so liable to burst in the hands of the sportsman. This, however, cannot be done, unless the purchaser sees it done himself, or has it done under the superintendence of some person on whom he can depend. The Birmingham workmen, if well paid, and well looked after, (to counteract the bad habits they have acquired from being employed in the manufacture of so large a quantity of goods of an inferior quality) would produce an article superior to any that could be produced at the same cost in any other part of the world."

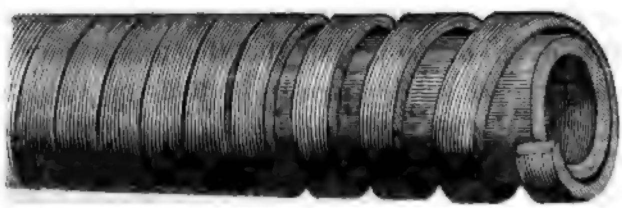
The Belgian welders do their work at considerably less cost in coal than our English workmen. Coal, it is well known, is very dear in Liege, and necessity may have taught them the extreme of economy both in the size of fire and the duration of it. They effect this by adding to two thirds of coal, beat into dust, one third of clay; this is mixed with the coal by being put into a wooden barrel and well stirred up together, the water drained from it, and this used even sparingly. The fire is scarcely larger than may be held in the two hands, while here little short of two hundred-weight suffices which is unquestionably a great and unnecessary waste. True the Belgian does not get through the great quantity of work the Englishman does by having "*a great many irons in the fire*" at once, but he certainly does it well and clean; the quantity of earthy matter in the Belgian's fire gives a great heat, and it is retained longer, but it is also free from the great excess of particles of charcoal.

All twist barrels undergo a similar round; the time and care bestowed upon them depends entirely on the price, varying from one pound per pair down to eighteenpence, and in some instances lower. At the period when we before wrote, we noticed the introduction of a villainous system of covering or plating barrels with fine iron, over a body of iron of the most inferior description. We here quote it.—

"The deceptions practised in this branch are numerous, and injurious to the trade. For instance, if you wish to have a heavy single barrel made from Damascus, or any of the best irons, and you send to the manufacturer the weight of iron required, the probability is, that unless you superintend the manufacture yourself, iron of an inferior quality will be introduced into the inside of the spirals. By this fraud they obtain iron worth three-pence a pound more than that which they knavishly insert into the barrel. We had been repeatedly told of this practice, but we were incredulous. However, we gave an order for four very heavy rifle barrels to be made of Damascus iron. They were made. The charge was enormously high. This was a matter of secondary consideration; but on pickling these barrels for the purpose of shewing the figure of the Damascus, we discovered at the muzzle that the iron seemed to be much more easily eaten away than on the surface. This led us to examine them, when we found

that the inside was entirely composed of iron, over which the covering of Damascus had been twisted. But, for the pickling, this fraud would never have been detected; yet for these barrels we were charged at the rate of two barrels for each. Since this occurred, we have subjected many heavy barrels to examination, and have found the fraud to be very common. The practice is not only dishonest, but spoils the gun. It destroys the shooting power in consequence of the metals being of different temperatures, not acting together at the moment of expansion."

It will scarcely be credited. We fear we shall be accused of "throwing the hatchet," when we assert three-fourths of the barrels welded in Birmingham at this time, which claim to be twist barrels, are all plated, "veneered" from the Damascus to the humble twopenny or *Wedgebury* skelp, a vast proportion certainly, but no exaggeration, it is true as that we have printed it. The method of accomplishing this is by having the iron required, rolled down into ribbons of a thin description, and these are twisted spirally round a tube of common iron having the fibres running length way or parallel with the bore. The accompanying cut will convey the idea.



Many will ask what inducement have they to take this extra trouble? Gain. The cost of Damascus is 7½d. per pound, the iron they use for this purpose is only 1¼d. A pair of barrels take 14 lb. of iron, say 6 lb. of this is Damascus plate, costing 3s. 9d.; 8 lbs. is common, amounting to 10d., instead of 5s., or a saving of 4s. 2d. a pair. A splendid profit if you order one hundred. The borer charges less, the iron is softer, the filer has less, and all items clubbed amount to something. The facility with which they can do this is wonderful, it clearly establishes their ability and proves their claim to be considered the cleverest *blacksmiths* on the face of the earth. It is not only the best descriptions of iron they plate with, but twopenny skelp is more in use than all, for it is now rare to meet with *painted* barrels. All are *genuine twist barrels warranted*, for they are mostly all plated, even down to the gun costing but fourteen shillings, wholesale price. It is a subject of serious import, one which the gun-makers, either metropolitan or provincial, should resolutely condemn, for safety as well as the goodness of shooting cannot exist in perfection in any such constructed barrels. We have met with plated barrels in guns which cost the purchaser thirty-five guineas; in some of the first maker's guns we have detected them, for the *perfection* of the fraud is wonderful, and but few can detect who are not

strictly up to "the move." The application of a portion of sulphuric acid into the tube at the breech end of the barrel, is the best way of showing the fraud, for in most cases it is bored all out at the thin portion of the muzzle, and the application there would, under these circumstances, be no test. We have found it necessary to bind the party supplying us in a penalty not to send one, and it might be well for others would they do so too.

We have frequently been applied to for advice in the recommendation of a barrel-maker, by many masters in the trade. It is at all times an invidious task to act as a selector for individuals, and to give praise to one man over another, more especially where the merits of workmen approximate near to each other, but however, in barrel-making, to be master of his trade it is not only necessary that he be a good workman, breeching and filing well, and possessing a good eye in putting barrels together (for here everything depends upon the eye) and finishing them highly. These we say are only a portion of the abilities a barrel maker should possess. Several of the London barrel-makers are exceedingly good workmen, for we have tried them all (Aston is a beautiful artist), but yet converse with them, and you find the technicalities of the work is all they can discourse upon; the iron, the vital principle, is Greek to them, they know nothing

about it, and care less. How can these men be guides in the right direction, they may have seen barrels welded, if so, a matter of chance. Even in Birmingham, where they cannot but see it daily, 19-20ths know nothing theoretically; you will frequently hear them heaping *anathemas* on a hard barrel when floating it, and wishing the man who invented steel barrels "*in the shades below.*" Ask these mens' opinion, and if they expect the job to file the barrels, they will surely recommend you iron *soft, stub-twist, or charcoal iron.* In our last work we named a very clever workman, and honest too, but he has now passed the "*bourne,*"—although the business has past, by the aid of the *church,* to a successor, yet as *talent* does not follow, as a matter of course, nor widows make it a *sine quâ non* that husbands be of the same trade, we cannot renew that recommendation. But our readers, who may hereafter have occasion to seek the aid of a barrel-maker on whom they can depend, will be well served if they apply to Mr. Thomas Kilby, Steelhouse Lane, Birmingham; no man in England knows better what iron is, and what it ought to be, and to a thorough knowledge of the nature of iron, may be added the merit of being as good a workman as any in the kingdom,a combination as we have already said rarely to be met with.

Boring and grinding gun-barrels, generally take place under the same roof. "The borer occupies a very small shop—the grinder a large one. Two

men and two boys are generally found in a shop. There are four benches, to each a spindle, in which there is an oblong hole to receive the end of the boring bit. The barrel is secured on a sort of carriage, which is at liberty to traverse the whole length of the bench. A boring bit is then selected of suitable size ; it is put into the spindle, and the point introduced into the end of the barrel. A sort of lever is then taken and hooked on to a kind of staple, or a piece of hooked iron (a number of which are fixed in one side of the bench the whole length), passed behind the carriage to force it up to the bit, which is removed and fixed again, until, by forcing up the carriage the boring bit has passed through the whole of the barrel. During this operation a stream of water is kept playing on the barrel to keep it cool. A bit, of larger dimensions, is then

introduced and passed through, and others of still larger dimensions, until the whole of the scales or blacks are entirely bored out, or until the barrel has become so large in the bore, as to preclude any further boring with safety. If the scales are of great extent, the fault is the forger's, and the loss will consequently be his. If the barrels be found perfect, they are sent back to the filer, or he comes to inspect them, in order to ascertain whether they be perfectly straight in the inside; if not to make them so."

The necessity of great care and attention to this point must be very obvious, for if not perfectly correct at this stage, it will require more skill and time to get it correct afterwards, than the generality of barrel-makers are inclined to bestow.

When the inside has been found to be all right, they are ready for grinding. Many barrel-makers turn their barrels entirely, by self-acting lathes, and thus obtain a correct taper from breech end to muzzle. Experience has clearly convinced us that this is not the best shape, but slightly hollow towards the muzzle is preferable, as additional weight there is decidedly injurious, and the shooting of barrels lighter constructed is decidedly better.

"The generality of Birmingham barrels are ground to the size required on large stones, which revolve at a terrific rate. The skill acquired by many of the workmen is astonishing. Over and over again,

have we seen barrels coming from the mill put into the lathe, and found almost as true as if they had been turned. They have a method of allowing the barrel to revolve in their hands at half the rate of the stone, and by this means they grind them so fine that many would be puzzled to determine whether they had been turned or ground, were the barrel smoothed lengthways, merely to take out the marks of the stone. We have seen the squares of a rifle barrel ground as perfect an octagon as the eye could assist in forming. Best barrels are generally turned after they are ground. Inferior barrels are struck up with a large rubber, or smooth, by boys; in some instances by women."

There is one advantage derived from grinding barrels, namely, that the friction of the stone being continuous, the temper of the barrel is not so much affected as where the tool, in the slide-rest, is cutting a considerable portion at once, for all barrels are best, and superior to their compeers, which require least metal to be either ground or turned off their surface, as there is a density on the outer which is not in the interior portion. The harder the material, the less the extent of this objection.

To obtain truth, it is important that they should be turned. "The way of fixing them in the lathe is by having a number of plugs or mandrils, which are perfectly true, and of various sizes, to fit different bores; these are centered and put on the centre

of the lathe; a carrier is then secured on a part of the plug that projects out of the breech-end of the barrel, and then put into the face-plate of the lathe, which carries it round. The leading screw that travels the slide-rest, is then set in the angle the barrel is to be turned to (though some lathes have not the power of alteration, but turn all barrels in one angle); the slide is next adjusted to the thickness of the muzzle wanted; and, when all is ready, the lathe is set going, and the leading screw is turned at the same moment by the machinery connected, which keeps the tool cutting sufficiently keen, to turn a barrel in about twenty-five minutes. This being done, nothing more is required than a fine smooth file to remove the marks of the tool. Of this mode of turning barrels, there can be no doubt of the superiority, if due care only be taken with the tool. If it get blunted by any scales or impurities, it is apt to tear pieces out of the barrel, similar to the rings that may be noticed in a slovenly bored barrel, owing to dirt getting on the edges of the bit. In turning a barrel by a common lathe, it is fixed in the same manner as before; about an inch of the surface at the breech and the muzzle is turned to the diameter wanted. The rest is then removed, and half an inch more is turned four or five inches from either end; then another half inch, at another distance of four or five inches, and so on, according to the length, making an allowance each

time in the depth of the turning according to the taper of the barrel. The iron between these cuttings is then filed off by floats the lengthways of the barrel, or more frequently ground off; this is a sure mode of getting the barrels perfectly straight on the outside, and without any of those hollows and shades which may be always discovered in an ill-made barrel. It is astonishing how beautifully many barrels are struck by the float. The mode of turning by the lathe is, however, cheaper."

There is a great diversity of opinion as to the proper inclination of a pair of double barrels. It is needless to state the precise distance at which the converging lines drawn from the centre of each barrel, and indicating the inclination of the barrels to each other, should come to a point. If we take the point of convergence of those lines at 2½ yards, it will follow that at 40 yards each barrel, were it fixed in a vice, would throw the centre of its charge six inches on the opposite side of the mark, or body fired at; but if the gun be fired from the shoulder, the recoil will invariably cause the gun to swerve outwards, so that at that distance, it will never fail to throw the shot in a good direction for the mark or bull's-eye.

"The subject may be understood by the following observations. All tapering substances, when laid together, were the taper extended, would come to a

point at a certain distance. Gun-barrels are made to taper towards each other, and some more than others. To make them uniform, it requires that they should be reduced or flattened to allow the thick or heavy end to joint closer, to allow the point of convergence to be extended to a greater distance. If then, we take two barrels, two feet eight inches long, and having a solid substance of metal at the breech, of 3-16ths of an inch each, and 1-16th at the muzzle; it requires the difference 4-16ths to be multiplied 45 times (there being that number of lengths in 40 yards) to ascertain what distance the points of the different lines are from each other, which will be eleven 4-16ths of an inch, or five 10-16th inches from the centre or line of sight. If you wish to reduce it from the centre, you have to join the barrels so much nearer at the breech; or should the inclination be too little, the muzzle must be jointed closer. As, however, all guns are now made very heavy at the breech, they very seldom require any closing at the muzzle, though it is customary to do it, and to a great extent; but it is owing to the ignorance of the nature of shooting."

"Different lengths require a difference in the height of the rib. A greater height is also required for a person accustomed to use a crooked stock; and less height for one accustomed to the use of a straighter one; and so on. Few barrels are to be

met with in which the elevation is sufficient; a species of innovation much practised by gunmakers of the present day, whatever merit there may have been in the original invention, there is none in "the improvement," as they term it. Take any of the modern barrels, and calculate what is the real elevation of them, and you will find it is not equal to the distance that charges will droop at forty yards, when we consider the very large charges of shot that many are accustomed to use, without a corresponding quantity of powder. It remains then to be decided what elevation a gun should have for that distance."

"We have tried the experiment some hundreds of times, with guns of all descriptions, both with a rest and from the shoulder, though standing as firm as possible; and by turning quickly round, and firing (as we might do were a bird to spring in a situation where we could get only a snap shot) against targets such as are used in military ball-practice, being about six feet high, and by means of which you could perceive where the body of the shot had struck. We have also fired against the steep sides of those beautiful sand banks of which we boast, on our late immediate coast, and on which, from their smoothness you can tell every shot that has struck them. Our conviction is, that almost all guns charged, as is the custom, with heavy charges of shot, droop full twelve inches in forty yards,

though by using small charges of shot you will find them to be thrown much more correctly than the heavy charges; so that it is possible to make a gun too high on the rib for a shooter who thinks more powder and less lead preferable to much lead and little powder.

"The elevation we have given, will be found to be as near what is requisite as possible, if we continue to load as heretofore; if reduced charges of shot be adopted, a less elevation will suffice. To ascertain what elevation at the breech for the above scale is requisite, take the thickness of the breech and muzzle, and multiply the difference by as many times as there are lengths of your barrels in the forty yards, and you will then ascertain what elevation they give of themselves; and to make up the difference wanted, must be the elevation of the rib, which may be calculated in the same way as the barrels; the length of the barrels being the only way of obtaining a correct idea of the height required. If making Woodcock guns, less elevation is required, the distance of shooting being shorter. In large guns, a greater elevation is necessary. We believe, however, Colonel Hawker has fallen into an error, when he says that long guns require a greater elevation than short ones. But does not a long gun keep the shot more together? Is not more force generated? and is not the initial velocity greater than in a short gun? If these be

facts, why is more elevation required, if the shot do not droop? We apprehend the Colonel means, if the same height be required to be given above the mark. Nothing can be plainer than this—that if one pair of barrels be four inches longer than another, and the elevation the same, there cannot be as many lengths in the forty yards of the longer barrels as of the shorter and hence the difference when multiplied. We think, therefore, he cannot have taken into consideration, the superiority in their shooting, for there cannot be a doubt, that, if a gun keep the shot together longer, it cannot require that allowance for drooping which a shorter gun does.

"As soon as the barrels are properly jointed, care must be taken to see that they are perfectly level. If the barrels are not level, it will be impossible to shoot correctly, as one barrel will throw the shot above, the other below the mark. This being done, the barrels are bound together and brazed with hard solder or brass, for about four or five inches. Greater injury cannot be done to barrels than by this pernicious practice, for they cannot be brazed without being heated to a white heat; by this heat, all the advantages derived from hammering are dissipated at once—the condensation is gone, and the strength is reduced at least $12\frac{1}{2}$ per cent.; and for what purpose? Under the pretence that the barrels are firmer, and not so liable to become loose. This is a point trivial in

importance compared to the excellence and strength of the barrel; for even if they have received no more hammering than is necessary in the forging, they are still injured to the extent of 12½ per cent.: for even beating them when hot improves them much, provided they be not heated again, but if they have been cold hammered, the injury is full 30 per. cent. A circumstance which shows how little the principles of gun-making are understood by the first gun-makers, the brazing of barrels being practised by all."

Mr. Wilkinson admits this, for he says—"The practice of brazing the barrels is decidedly injurious, by softening that part more than the other; but if they were only soft soldered, the inconvenience would be far greater, as the barrels would be liable to some accident by the repeated expansion and contraction that takes place in firing, as well as by the force required to turn out the breechings." We can only say, we have had considerably more than five hundred pairs of barrels made and put together with soft solder only, and not one pair has come asunder from any of the causes mentioned, nor ever will with fair play. On the contrary, barrels brazed can never be sound, for at some distance from the part heated for brazing, you cannot get the barrels retinned effectually, and thus for a considerable space between the soft and hard solder, there is no cohesion at all. Barrels brazed together

only for three or four inches at the breech-end, can never be sound, and almost invariably become so rusted under the rib, in a few years, as both to seriously injure the barrels, and force the rib upwards, therefore, if you hard solder at all, do so from breech to muzzle, as that will be preferable to partially doing it. We feel quite satisfied, and can prove it to demonstration, that this is undoubtedly the most injurious process to which iron can be subjected; and we believe the prejudice with which the London barrel-makers stick to this practice is productive of considerable injury to them, more especially when we recollect they are the advocates (in practice) of a very inferior quality of barrels (Damascus), an iron so susceptible of injury. The Belgian barrels and French also, are of good iron; and we fear not contradiction in asserting, their inferiority to English barrels mostly consists in the foolish practice of brazing together from end to end. Both chemically and mechanically it is a practice for which no valid excuse can be offered.

All barrels should have solid ribs for at least eight inches from the breech, and thus tend to lessen the vibration of recoil, as well as to render the barrels more sound and firm. No maker either understands science, or studies quality, who advocates brazing and hollow ribs.

Barrels intended to undergo the Birmingham "proof," have merely a simple plug screwed into the

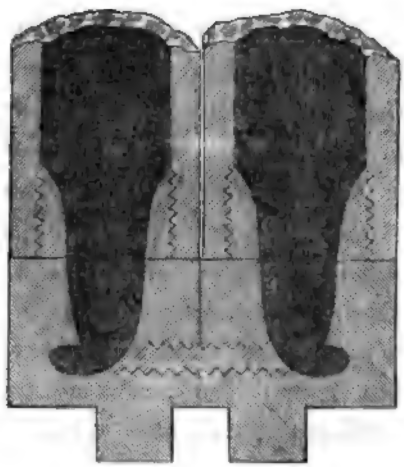
breech-end, with a hole through it to ignite the charge when the train is fired; *but those for the London " proof" are required to be soldered together*, and to be breeched, to prevent any lessening them in weight afterwards. This, a most excellent arrangement, we are sorry to say, has been rescinded, and they are now only required to be *flattened* a little at the breach-end, *(as if they were really jointed)*, a breach screwed in and thus proved singly not a whit better than Birmingham " proof;" as see under " Proof."

The invention of the patent breech was the emanation of a scientific mind, for it has been productive of more real benefit to the progress of gunnery, than any other improvement of the last two centuries. Experience and study, on the theory of guns and gunpowder, give the mind a much more enlarged view, if regulated by the established laws of true and sound principles. A want of study induces the individual to draw conclusions prematurely, and thus he is apt to fall, and to lead others, into error. We confess, that together with many hundreds more, we once concluded that the great advantage of the patent breech arose entirely from the loose state the powder was preserved in while in the breech, and thus being more instantaneously ignited. We have already shown that the quickness of powder, is in a great measure, the greatest drawback to its efficacy, and have been clearly convinced

that compression, in most instances, is beneficial by retarding, to a certain extent, the ignition; then here is proof positive, we have been on the wrong scent, running after a "Will o' the Wisp," and would soon have been immersed, if we have not already been in a quagmire.

There is the clearest evidence, that the only advantage to be derived from any conical form of breech, does not arise from any peculiarity attached to the ignition of the gunpowder, but solely from the action of the angular shape, or conical form, being best suited, or presenting the least direct surface to the action of the exploded fluid; the angles receive the blow and throw it off at the same opposite angle, and so on, without receiving any amount of force from the element striking it, and thus the elastic fluid is enabled to be resisted efficaciously. The cone becoming and forming an artificial solid base, to a certain extent, and as such, much more beneficial than the same quantity of powder ignited on a flat surface,—as a common plug breech for instance,—for here the quantity of direct space on the face of the breech receives the same impulse as the ball projected, and is acted upon in precisely the same ratio, in proportion to their different weights. In a musket of 11 lbs., the comparative weight of gun and ball is as 1 to 176, and exactly in that proportion will be the distribution of impulse from the expellant fluid. It thus becomes a plain ques-

tion between the patent breech and the flat surface of the plug. The two halves of a parabola inverted, or the shape of a parabolic spindle, will be the best shape, according to the laws of science; the representation given below is as near as we can get our engraver to represent our views of the best shape o breech.



A great variety of forms are at this moment advocated and puffed, some of them of the most unscientific description possible; but yet it matters not in England; for if a zealous advocate could be found, to puff well the advantages of the old-match lock, he would find believers, so prone are mankind to pin their faith on the veriest quackery. The absurdity of exploding gunpowder in a *shell* at the breech of a gun, and persisting in the advantage of it, is cer-

tu' ıly tilting at a *windmill.* It will be asked, how is it that government do not adopt the patent breech in the musket? A want of science in the direction, and from an imperfect system of experiments; in fact, they say they do not find any advantage from the patent breech in a musket, that the range is as great without it as with it. We believe them; but what is in fault, not the form of breech, the windage alone does and will regulate and bring to a medium, the projectiles fired from a musket, with all the various charges you may fire with, which every sportsman will comprehend. The size of the ball of the musket is near a 16, the bore of the barrel 11, or five sizes difference; thus there is sufficient space for *one half* the explosive fluid to escape between the diameters of the ball and tube, clearly showing that a musket-ball travels amidst the expellant fluid, and all the additional quantity would not give an additional velocity. But in fact, the contemptible range of a musket is a sufficient answer. Government never considers the personal comfort of the private soldier, or it would have long ago put patent breeches in military arms, for, setting aside the propellant advantage, the recoil is, as near as we have been able to ascertain, under the same circumstances as one to two in favour of the angular breech; this is no exaggerated statement, we have tested it, and we stake our reputation upon the accuracy of it. But the superior knowledge of

projectiles which artillerists have obtained, since the extensive introduction of chambers to nearly all descriptions of ordnance, is the clearest proof, were any wanting. The use of the *Gomer* form of chamber, is nearly universal in brass guns; the shape is the fustrum of a cone with a spherical bottom. The inutility of enlarging on, or describing, the various shapes or plans of breeching, will be apparent, as our intention is to point out the science of the question, not the folly of every invention.

We shall again quote a portion of "The Gun,"—on the lock:—"There have been many good lock-makers, but still they have, we fear, decreased much of late. From the great demand for second-rate goods, they are rarely called upon to make a first-rate article; and thus, from being so little accustomed to make any but inferior locks, they, of course, are out of practice. Instead of the manufacture of the best being encouraged, it is becoming every day more rare to meet with a good one. There is a great degree of skill displayed in the making of locks, though to the casual observer it does not appear. On the simple hanging of the swivel depends all the sweetness of the play of the main-spring; and on the placing the hole for the scear-pin depends the sweetness of the scear playing on the tumbler. Many who now pass for excellent workmen would find this a difficult undertaking, simple as it may seem, without a pat-

tern by which to work. All locks for percussion should have the greatest strength of main-spring at the moment they strike the nipple, or, what is termed, when the lock is down. On the pitching the scear, depends the cutting of the bents, and on their formation, the danger of the lock catching at half-cock. when the trigger is made to pull easy; but these observations will be understood by a lock-maker better than we can explain them."

"The quality of all locks depends on the price they cost filing, and without you pay the workman a proper remuneration, you may rely on having them somewhat inferior, or in accordance with the price, which it requires a workman to point out; so that, without doubt, any person, if not a first-rate judge, is completely dependant on the honesty of the workman."

There is more real science displayed in the construction of a gun-lock than mechanics in general imagine. The placing or hanging of the swivel on the arm of the tumbler, is an arrangement of leverage partaking of the multiplicate, as the weight when at full cock, is lessened by the lever bringing the moving force in the immediate vicinity of the axle, and when down on the nipple, increasing or multiplying that force by the divergence. The Barside lock possesses this advantage to a greater degree than any back-work lock yet made has obtained; though we perceive no hindrance, if properly

understood and tried; for it is only to obtain a greater length of arm, and a proportionate length of swivel.

The family of the BRAZIERS, of Wolverhampton, have long been celebrated for the goodness of their locks, arising solely from the fact, that they take more pains, and will not manufacture any but the best; for it would be ridiculous to suppose there are not plenty of men equally as good, and, probably better workmen than themselves, in the kingdom, were they properly encouraged, and confined to making nothing but first-rate articles. They have apprentices and journeymen: and it is preposterous to imagine they file the tenth part of the locks they furnish to the trade; but yet they have always, and deservedly, obtained a much better price than any other lock filers out of London. Many of the London makers employ them exclusively.

The operation of false breeching, jointing locks, stocking, &c., are merely mechanical operations, requiring, certainly, great skill and ability, but yet involving no principle further than is contained in the proper suiting of the shape to the make of the user. An endless variety of opinions have always existed, and always will exist, on the description of bend or crook, best fitted for rapid shooting, as flying or running. We have instructed, and with success too, many young shooters, and by commencing with a long and straight stock, have attained a per-

fection in shooting scarcely to be excelled; and they never entertain afterwards any wish to change either length or bend. Therefore we recommend to all beginners to use as long and as straight a stock as they can *conveniently* bring to the shoulder. All practised shooters have generally so accustomed themselves to one shape, that it would be prejudcial to change. The practice of throwing off a stock at the butt or bending from the hand to the heel-plate, in a direction to the right, so that the eye may get more readily in a line with the centre of the breech and the sight, is a practice not to be defended on scientific principles. The body will suit itself best, and if the stock be not too straight, the eye will always find the true line.

The percussioning of a gun, (as the fitting in of nipple, boring breeches, filing cocks, &c. is termed,) is also a mechanical operation, requiring workmen of the very best abilities. The desideratum to be obtained, is a direct communication into the barrel, or absence of angles, ante-chambers, &c., therefore it is needful that the nipples should be inserted as near the centre of the breeches, if a double gun, as they can be conveniently placed, with the nipples standing, not upright, but at an angle of 45°, so that the blow of the cock shall be in or as near a line with the imaginary upright of the nipple as possible. The various plans of copper cap, copper tubes, and we know not how many other plans, will be discussed under the head of guns and shooting.

Finishing the stock, polishing, engraving, hardening, &c., are strictly without any science of consequence in their arrangements, and as such, it is scarcely necessary to occupy the attention of the reader respecting them. The best method of staining barrels is by the following recipe; but one material fact must not be overlooked. A considerable difficulty exists in staining barrels all steel, therefore the acid should not be so much diluted.

1 oz. Muriate Tincture of Steel.
1 oz. Spirits of Wine
$\frac{1}{4}$ oz. Muriate of Mercury.
$\frac{1}{4}$ oz. strong Nitric Acid.
$\frac{1}{8}$ oz. Blue Stone.
1 quart of Water.

"These are to be well mixed, and allowed to stand a month to amalgamate. After the oil or grease has been removed from the barrels by lime, the mixture is laid on lightly with a sponge, every two hours, and scratched off with a steel-wire brush every morning, until the barrels are dark enough; and then the acid is destroyed by pouring on the barrels boiling water, and continuing to rub them until nearly cool. The Birmingham people brown their barrels of inferior quality in the following way, to make them look equal to the best. They dissolve as much muriate of mercury as can be dissolved in a dram-glassful of spirits of wine; this solution is mixed with one pint of water, or as much

diluted as the person requires. A small quantity of the mixture is poured on a little whitening, and laid on the barrel with a sponge, rather lightly ; as soon as dry, it is brushed off, and a fresh coat is laid on ; and so on until the barrel is dark enough, which is generally about two days. The effect the mercury has on every one of the joints of the fibres is wonderful, it never fails to make them, in two or three days at most, a beautiful brown, while the other parts being harder, remain, comparatively speaking, quite light. The rust is killed by hot water, but after that, the barrels are suddenly immersed in cold water, which has the effect of heightening the brightness of both the colours. The appearance is beautiful, and equally as fine to the eye, as stub-barrels browned in the same way, though this process is mostly used for the charcoal iron and the threepenny iron barrels. The only method, in which there is no deception, is the smoke brown or stain; and, plainly speaking, this and no other is the reason the gun-makers condemn it. As the acid is decidedly weaker, and of course less liable to impart injury to the iron, by it no barrel can be browned to look well and fine but the best; or, in other words, none save those possessing steel in their composition.

"The method of staining is this; the barrels are anointed with a little vitriolic acid to cause the iron to receive the effect of the gas more readily; it is

then washed off, and the barrels rubbed dry. The forge fire must then be lighted, and blown up with coal possessing as much hydrogen gas, and as little sulphur as possible. When the coals are burnt, till they give out a clear white flame with no black smoke around it, the barrels must be passed gradually through that flame backward and forward, until the whole are covered with a black sooty covering. Place them in as damp and cool a cellar as can be procured, allow them to stand for eighteen hours, and, at that period, if the place is sufficiently damp, the iron parts will be found covered with a red rust, while the particles of steel still retain the original sooty coat. Scratch them off with a steel brush, the same as by any other method of staining; then take a piece of linen cloth, and wash or polish them with water and a little washed emery, and the steel will be found of its original bright colour, and the iron a shade darker, with the outlines of both distinctly preserved. Rub them dry, and again pass them through the flame precisely as before; but above all things be careful not to allow them to remain in the flame till they become hot enough to melt the solder. When you have once passed them through, do not be in a hurry to pass them again, but in both be guided by moderation; neither allow them, after the first time, to stand to rust, more than twelve hours each time; polish them as before, and you will find them a shade darker every smoking.

"Thus persevere, until they become as dark as you wish to have them. The utmost you can obtain is a fine purple-black colour on the iron; the steel a shade inclined to a copper colour, but if proper attention be paid to the polishing, it will not change much from its original colour.

"The barrels are taken out of stain in the same way, as by the other recipes, by hot water; but you must continue to scratch or brush them longer, for by that means you obtain a greater gloss. The principle of this stain is, simply the hydrogen gas contained in the coal acting on the iron, from being of a softer nature than the steel, which it does not affect, the flame also possessing a quantity of tar, it is imperceptibly embodied by the iron during the action of the oxide, and, when finished, by filling up the spaces created, it becomes decidedly more impervious to damps or wet, than the other stain, which is entirely composed of the oxide of iron."

The only objection to this brown has been found to arise from the discharge of the black colour from the softer parts of the barrels, being but coal tar, the sweat of the hand, hot water, in washing, &c., invariably extract it in a short time.

The recipe, for the Birmingham imitations, is as follows :—

1 oz. Sweet Nitre.
½ oz. Tincture of Steel.
¼ oz. Blue Vitriol.

PLATE I.

ANGULARLY LAMINATED STEEL BARRELED GUN

LAMINATED STEEL BARRELED GUN

6 drops Nitric Acid.
14 grs. Corrosive Sublimate.
1 pint of Water.

When the barrels are dark enough, drop a few drops of muriatic acid in a basin of water, and wash the barrel slightly to brighten the twists.

This last process is borrowed from the Belgians. In the working of their extreme fine Damascus barrels, they found a very great difficulty in staining them to produce a clear and distinct figure. The way they now proceed is either to eat away the particles of iron leaving the steel prominent, and the barrels bright, or they polish them extremely fine from end to end, and then blue them in a stove with charcoal; it is thus described in the notes to a German translation, by Dr. Schmidt, of Weimer, (of my last edition of the) "Science of Gunnery."

"The method of browning the Damascus barrels, which are so much admired in England for their distinctness in colour and beauty of figure, is obtained very simply; namely, first burnish the barrels very fine; then cover them with bone oil all over, pound, or drop, or strew wood ashes all over; then heat them in a cage of wire filled with charcoal, until you obtain a dark first blue; after cold, mix a small quantity of sulphuric acid in water, (a quarter pint with so many drops); then take a hard brush and apply it to the barrel, when the acid will extract the colour from the steel, leaving the iron

with its greater adhesion covered with the blue colour. Great care must be used, and skill displayed to keep a good colour, and not to extract too much."

This we cannot do, because we solder with tin.

Having now detailed as much of the "*modus operandi*," as will, we fear, exhaust the *patience* of the greatest possessor of that estimable virtue, we shall endeavour to give the reader a little peep into the "*sanctum sanctorum*," the gun-makers' work-shop. We have been detailing what course ought to be pursued in the construction of guns of the best quality only, and before describing anything else, we shall finish with them; "we are not," as some would say, "going to expose the *whole* secrets of the trade;" oh no, only a portion.

There are six qualities or varieties of mixtures of iron for barrels of best quality, the plate-facing contains two kinds finished, composed of steel entirely, but of different degrees of carbonization; one is composed entirely of a laminated series containing many scores of distinct lamina in the thickness of the sides of the barrels, twisted and beat into tortuous shapes. The other, of larger lamina, but showing the edges of the lamina at an angle with the length, and thus appearing larger than if presenting the side or end of the plates. Care must be taken that the great proportion of the fibres shall always run round the tube, so that the

greatest portion of strength may be obtained, together with a beautiful figure. The cost of this arrangement is considerable, as it involves a considerable waste of metal, and occupies a considerable time to work and re-work, twist, faggoting with the bars placed in various forms, at angles to each other, at right angles, plaiting three or four rods together, as a lady does her hair, cutting these into pieces, faggoting and welding them into one, and, in short, undergoing an endless routine of manipulations, which it would be strictly unprofitable to detail, but all productive of cost. An ingenious man may work and improve metal of this nature until it cost the price of silver, and, if judiciously done, improving it still, even until he has wasted 90 per cent. of the original material. The ultimate nature and property of iron has, as yet, never been ascertained; it is capable of being condensed until it becomes nearly of, or equal to, the specific gravity of lead or silver. No pursuit, mechanical or philosophical, presents so great and so beneficial a research, to the whole civilized and scientific world, as iron. We could twist, and re-twist iron, until, from the beautiful and interesting results, it would become with us a sort of "monomania." We wonder not at the variety in a Damascus sword-blade, the mind conveys us to the scene, and a regret arises that we did not live then, yet still it is but a mechanical arrangement directed by an ingenious mind, and the ultimate

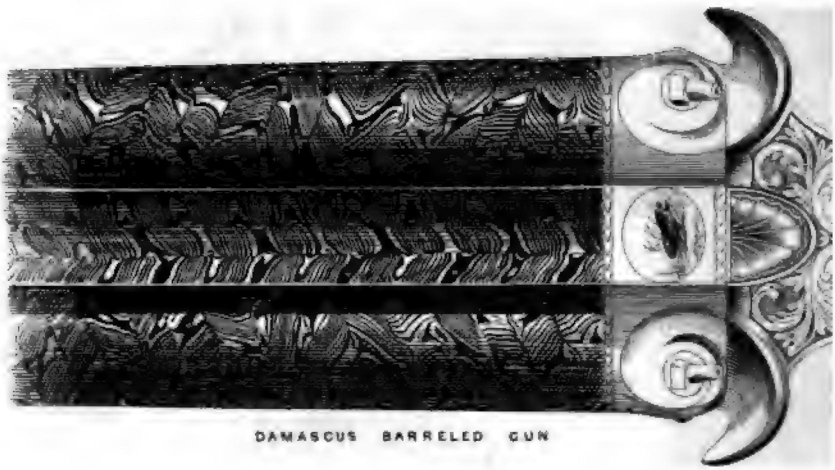
benefit, apart from the beauty is only imaginatory. For the whole simply proves, that the Orientals were artists, and that they were appreciated; if it were so now, we too could do all they ever did, and more.

The opposite plate represents our mixture in imitation of Damascus, the process necessary to produce it, as well as its companion, has already been described. These two also, come under the head of best barrels, as they are costly, and when honestly made, (not plated) make, with the defects before enumerated good barrels.

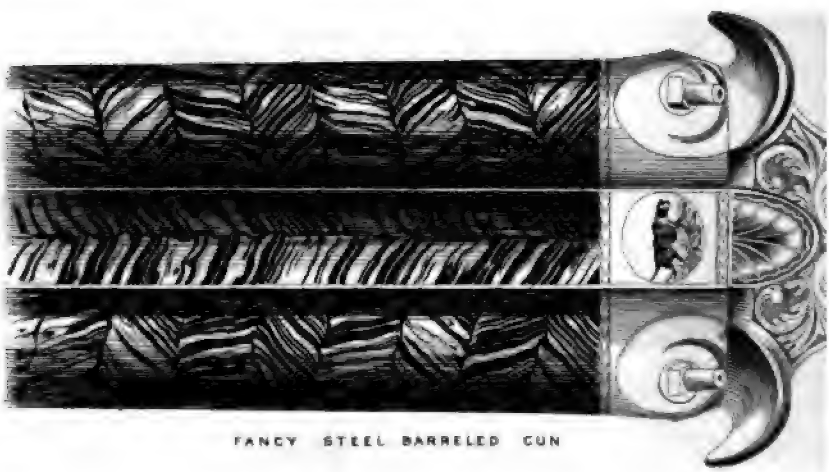
The cost of a really good first-rate gun, must and will always vary, according to the circumstances of manufacture, or the peculiar arrangements of the manufacturer. Joseph Manton is entitled to the gratitude, not only of the present generation of gun-making fraternity, but of all succeeding ones; for this reason—he not only gave a character to English guns, but so linked his name with improvements, as never to be forgotten. His was the mind to know and appreciate the value of go od work—he raised the English artizan with himself, and left them the acmé of mechanics, for without any invidious comparisons of the abilities of other professions we may say, a first-rate workman as a *gun-maker*,*

* Barrel welders, borers, lock-filers, &c., are not technically gun-makers, the latter are those workmen who, having barrels, locks, wood for stock, &c., make them into a gun. It has been customary to say gunsmiths; this appellation can be applied to the worker in iron only.

PLATE. II.



DAMASCUS BARRELED GUN



FANCY STEEL BARRELED GUN

we do not mean anything but a gun-maker, is one of the very best mechanics England can boast of, or in truth any part of the world. Gun-making is the profession of a man of mind; any man, or any workman cannot make a gun; if they are not possessed of the ability of the head, they cannot work by square and rule entirely, as other mechanics do; no, the *gun-maker* is an artist, and Joe Manton made him so.

It is true, we have not now that complex machine in which Joe so peculiarly excelled, the flint gun, but we have a more simple and a more efficacious one in the percussion. He was not so fortunate in this as the former, but all men are at fault sometimes, and he could not be expected to fondle the child of another; no, it was for the first improvement of the *workmanship* his memory must be revered. The English gun, at his commencement, was as far inferior to what he left it, as the tawdry manufacture of the continent is to ours of the present day. The prices he obtained were enormous certainly, and all men should be paid well, who can prove they possess extra brains and ability; he remunerated his workmen on this scale, and he unquestionably had the first batch the world ever saw. We can possibly, at this period, excel them, for the *pupil* sometimes exceeds the *tutor*, but this arises from laying firmly the foundation of a superior sytem.

All the ambition our mind has ever entertained, has been to be able to make an article that will not, and cannot be exceeded in goodness, neatness, combined with taste, by the generation in which we live. This we may never yet have accomplished, but we may be excused if we try. The profession will grant that we had the wish to benefit the manufacturer by improving, if we had not the means to do it.

The best or as good a gun as ever was constructed, or ever will be, should yield the maker a profit at £35—cheaper it cannot be done, if *honestly the best*. We have studied and estimated the cost both of town and country-made guns, and are aware the London-maker would be barely remunerated at this rate, from the extra expenses he is liable too. But we also know, without any doubt, that as good guns can be, and have been, made in Birmingham as ever were produced in London. The facilities the former possesses, will always tell in that competition, and Westley Richards is an example, for not much better guns can be manufactured than he produces daily, as most London gun-makers fulj well know. Let but some individual with the head and the *cash* try it, and a fortune would be the result, as better workmen, if well looked after, cannot be found in the world, but their talents are prostituted in the production of inferior qualities and when wanted are, of course, *amiss* for any great

effort. Birmingham is a workshop where, if one tool does not suit you, you can get another; if a barrel be faulty, or locks inferior, you can have a new one in the time a London house would take in ordering it.

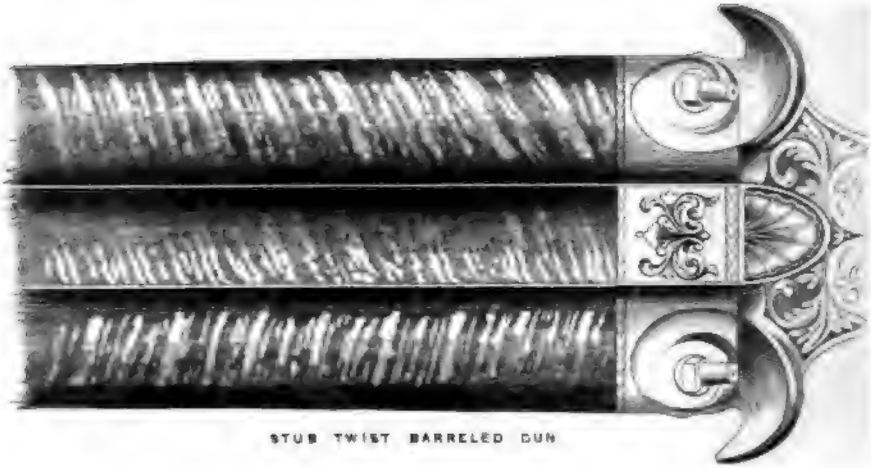
These remarks are not dictated by any feeling of dislike to the metropolitan makers, but from a conviction of the truth of the question, for establishments like Joe Manton's are not met with in London now a days—not one house in the business can maintain them.

Some years have elapsed since the foregoing remarks were made, and those years have confirmed us in that belief. We cannot possibly have any wish to depreciate; what benefit would be gained by it? We cannot praise the London manufacturer against conviction: we are unfortunately too much in the secret; we know too well how the vast majority of London guns are made, and where we can see fifty in a day casually. Then why keep up a distinction that does not exist? why call a gun London because the seller rents a shop and calls himself a gun-maker? why not at once say? our manufactory is in Birmingham, as we find we can make both better and cheaper there. This is truth, and ought to be told; it is now the extreme of folly to say, "these are *Brummagem* guns," the term only applies to the "*Rubbish*," the low priced article, which no honest man has hardihood enough to brand with

mity, a cooperative feeling, both in London and Birmingham, a well arranged, mutual improvement society would be the means of driving the "*rubbish*" or the sordid manufacturer into a reformation of his ways, would show him honesty in his manufactures is as essential as honesty in his outward dealings. We lament that this untoward feeling should exist, and more especially in Birmingham, where they possess all the elements for future prosperity, but which is blighted from the want of an expansive, liberal feeling to each other, and by that "*millstone*" round the neck of the trade, the present proof houses.

The plate opposite represents stub twist and stub Damascus—the former, if properly attended to in manufacture, will long hold its station in the construction of best guns. An excellent second-rate gun can be made for about £25, with case, &c. There is at this moment a great number made—in fact, very few cost more, even the present best production of Birmingham. There could be made there, if occasion demanded it, and if there were a head to direct and control—superior articles to any yet produced. The generality of gun-makers in Birmingham are mechanics, and when you say this, all has been said that can be, a vast majority of excellent workmen have never fired a gun, and knew nothing, strictly speaking, of its use. A gun-maker, in the true meaning of the word, is, or ought to be,

PLATE. III.



STUB TWIST BARRELED GUN

STUB DAMASCUS BARRELED GUN

an enthusiast; delighting in, and living for, his art alone, without being clogged with a prejudiced or stubborn mind, a soul to conceive or grasp the emanations of genius; for a vast mine, containing the veins of improvement and discoveries, is yet to be opened from the depths of "Chaos," where they are yet buried and unknown.

We have already sufficiently enlarged upon the inferiority of barrels made from charcoal iron. A great quantity of these guns, are made or got up for the general factors, who take orders for every thing, from "a needle to an anchor," but they manufacture nothing, they only employ their money *for a moderate return*. The hardwareman is the principal seller of this description of guns, he generally pays between ten and twelve pounds each for them, and retails them at from fourteen to fifteen pounds, if he can find flats to believe they are as good as they can get elsewhere for twenty pounds. Very curious that it is so, but we have known a tradesman of this kind, sell more in a season than the whole three gun-makers in the same town in the same time. A certain portion of his warranty was correct, that they were as good as could be got elsewhere for twenty pounds. For the articles, as far as barrels and locks are concerned, are identically the same—so content are the generality of gun-makers to live like the snail, not caring how the world goes, so long as his house is whole above

his head, and rather than try either to improve their productions, or to meet the exigencies of the times, they are content to allow the trade to be injured; and a footing given to the inroads of rubbishingly manufactured articles, both to their own loss and the discredit of the business generally. The enormous prices gentlemen have been charged for provincial-made guns, of the most inferior quality, has driven them to obtain still worse at a less cost; an honourable and tradesman-like method of conducting business will always be appreciated, and if a gun be required at a low figure, an honestly-made article might be furnished at a price to suit the customer, and of equal and mutual benefit to buyer and seller. No, but this will not do—high prices or no orders. It would do very well, if nothing but high-priced articles were manufactured as good in quality as professions would lead one to expect; but few provincial makers have the means to do this; an establishment sufficiently large can only be supported in certain districts. The profession must excuse us, we have both their interest, combined with that of the sporting world, in view, and they will do us justice in supposing we have no other end to serve. We do not include all, only a part of the profession, for we are aware there are many and great exceptions.

The ironmonger receives these guns, and disposes of them as stub-twist barrels—he knows no other,

PLATE. IV

CHARCOAL IRON BARRELED GUN

THREEPENNY IRON BARRELED GUN

nor would he care if he did. A flashy outside is very captivating to the novice; but one or two years' use will soon show the quality of the article. The wood then shrinks, the glue and wax wash out of the fittings, and an apparently crazy and breaking-up constitution displays itself most clearly: for work put together at a certain price will have only an uncertain duration. Were we free of the gun-making profession entirely, and asked what was our conscientious advice in the purchasing of a gun, we should decidedly say, buy a gun from no one who has not a character to lose, who is not answerable for the article he sells, and who is not also capable of judging of the quality, and one who knows the value of good materials. The trade is overrun with swarms of Jew-salesmen, and men, from situations in life, who cannot, nor ever will be, able to duly understand and appreciate the responsibility attached to the profession of a gun-maker.

There was one individual in Birmingham, but now multiplied into a firm, who realised a considerable amount by manufacturing only for two or three sale shops of puffing celebrity, in London, guns of this quality, and so extensive are their orders still, that an engraver is kept in full employment by themselves alone, and the excellence of his forged imitations of names, &c., has been the *wonder* and *admiration of thousands;* so devoid of shame and debased in intellect do men become from a perseve-

rance in evil. Joe Manton's guns have become like pictures of celebrated masters; had all of them produced one per hour during their existence, they could not have produced one half of the number that bear their names. Guns, made of threepenny skelp iron, are plentifully to be met with in sale-shops and pawnbroking establishments, generally bearing false colours, *hailing from* fictitious ports, bedecked with painted stocks, and imitation gold tawdry, and fancifully designed silver ornaments; and the whole mechanical arrangement, to use a *Brummagism*, as if they had been pitched together. A decent gun could be made of barrels of this quality, if constructed a little heavier than usual, and would be perfectly safe, and suited for the use of those who could not purchase better, if firm and soundly fitted up, with decent locks, sound stock, &c., for about eight guineas; but you can get them by the hundred, in Birmingham, for £3: 15s. each, and, if you particularly wish it, at £2: 15s., or less, and with plated barrels, single guns about the half.

We have now reached the utmost limits of civilization, and are about to pass the great desert, or where science is never seen or heard of, except it be in the person of a spurious son, an imitation in a small way, an inventor of deceptions, a counterfeit in name and reality! Guns! Call ye wood and iron guns? Pocket Volcanos would be a fitter title—portable Vesuviuses—for no one can possibly expect

any thing but the flowing of burning *lava* on his hand, who uses such compounds of wood and iron. We have, for the edification of those who use such, added a list of the prices and cost of manufacture; no one need doubt the statement, for it is literally true, and with the possibility that the items may vary a penny or two, the whole is substantially correct, and, as such, we will answer for them.

Cost of Material and Workmen's Prices for making Double and Single Guns of Twopenny or Wedgebury Skelp Iron Twist Barrels.

DOUBLE GUN.

	£	s.	d.
Double barrels, twist, patent breeched,	0	12	0
Pair of locks . . .	0	2	0
Wood for stock . . .	0	0	6
Set of cast furniture . . .	0	0	5
Stocking	0	2	0
Screwing together . . .	0	3	0
Percussioning . . .	0	2	0
Polishing and engraving . .	0	1	0
Varnishing (including painting) .	0	0	6
Browning	0	0	6
Finishing . . .	0	3	0
Ramrod, tip, and worm . .	0	0	6
Small work, nails, escutcheons, wood screws, &c. . . .	0	1	0
	£1	8	5

SINGLE GUN.

	£	s.	d.
Single barrel, twist, &c. . .	0	5	9
Lock	0	1	0
Wood for stock . . .	0	0	6
Set of cast furniture . .	0	0	4
Stocking	0	1	0
Screwing together . .	0	2	0
Percussioning . . .	0	1	0
Polishing and engraving . .	0	0	8
Stock varnishing and painting .	0	0	4
Barrel browning . . .	0	0	4
Finishing	0	2	0
Ramrod, tip, and worm . .	0	0	6
Small work, &c. . . .	0	0	8
	£0	16	1

Common iron barrels plated with this iron can be furnished by barrel-makers, double for eight shillings per pair, single for four shillings each, which deducted from each, gives double complete, £1 : 4s. 8d.; and single, 14s. 4d. each; and for these we have known the factor charge the ironmonger, double, £3 : 10s. each, and £1 : 15s. single; so it is strictly an imposition on both sides, one charging £5, and the other £3. Now for the next,—bad as is the preceding, this is infinitely worse,—the former costs two-pence per pound, the present varies

from one penny to one penny farthing per pound. Sham damn iron is similar in nature to brass, a metal with fibres certainly, but they are like the fibres of willow compared to oak, an iron soft and spongy, capable of being condensed to an immense degree. All slave gun-barrels are made of it. The many thousands of mutilated wretches, who have lived to curse the cupidity of their fellow man, form not a bright side in the picture of human nature; how debased, how low, and how contemptible man becomes, who, forgetting honesty, sinks all other laws both human and divine for gain—paltry gain, would sell all, even his immortality. Mungo Park details some of the lamentable atrocities committed by these guns bursting; but were you to bawl in the ears of those employed in the construction, all these and a thousand more such direful effects of their handywork, you would not affect nor abate one, in the number of these infernal man-traps. But it is useless to detain the reader. The proof company is alone,—we beg pardon,—the legislature is alone to blame, in allowing the existence of a monopoly which benefits no one but the shareholders, as we shall hereafter show.

Cost of guns made of "Sham damn iron."

DOUBLE GUNS.

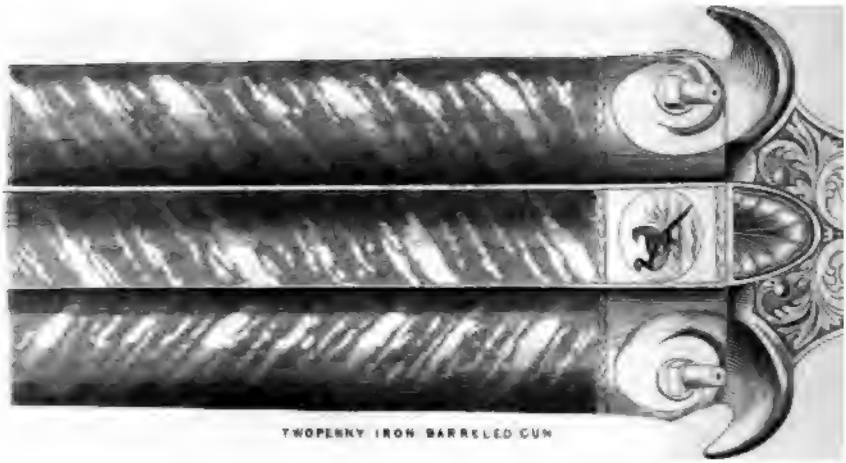
	£.	s.	d.
Double barrels, plain iron, with side huts, per pair . . .	0	7	0
Locks . . .	0	1	6

	£	s.	d.
Wood for stock . . .	0	0	6
Stocking . . .	0	1	2
Furniture . . .	0	0	5
Screwing together . .	0	2	0
Percussioning . . .	0	1	4
Polishing and engraving . .	0	0	9
Varnishing and painting stock .	0	0	4
Painting twist barrels . .	0	0	4
Rod, tip, worm . .	0	0	4
Small work . . .	0	0	7
Total . .	£0	16	3

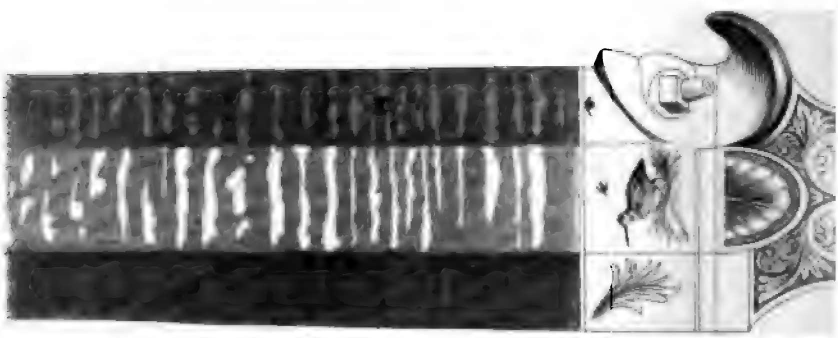
SINGLE GUNS.

	£	s.	d.
Single barrel, ribbed and breeched .	0	3	8
Lock	0	0	9
Wood for stock . . .	0	0	6
Stocking . . .	0	0	8
Furniture . . .	0	0	4
Screwing together . . .	0	1	4
Percussioning . . .	0	0	9
Polishing and engraving . .	0	0	6
Varnishing and painting stock .	0	0	4
Painting twisted barrel . .	0	0	3
Rod, tip, worm . . .	0	0	4
Small work . . .	0	0	4
Total . .	£0	10	9

PLATE. V.



TWOPENNY IRON BARRELED GUN



A SHAM DAMN BARRELED GUN

The above guns are sold by the score to the factor, at £20 and £12 relatively. The Jews sometimes get them at that, or a lower price, as money happens to be plentiful or scarce. There is a convenient description of tradesmen in this town of hardware, whose establishment bears the euphonious titles of the "*slaughter shop*" and "*blood house;*" and in these emporiums of the productions of the needy, may be obtained gunnery of all kinds, as well as all other material, the productions of Birmingham. If the article costs little manufacturing, it costs these men still less. A pawnbroker is a gentleman compared with the slaughter-master; if he charge you a good per centage, he will return your goods if you have the needful, but the other is a cormorant, who swallows the food of the weak, and once past his awful jaws he cannot be made to disgorge. Here the Jews and itinerant hardwaremen find a ready market, he has always a stock. The wants of the poor are always pressing, and the gun-making portions of the inhabitants of Birmingham are not *over provident*, seldom caring for what to-morrow may bring forth. The painted pair is faintly pourtrayed in the opposite engraving, and the uninitiated may be able to detect or recognise, what we have endeavoured to acquaint them with. The merits, the very high merits they possess.

We shall just give the cost of the various items in the fitting up of an imitation gun for the African,

combined with an *imitation* musket for the same market; the former is not so bad nor so deep in the slough of danger as the latter, as the one is barely half an inch in the bore, the other full three quarters of an inch, and yet their weights are not dissimilar.

Cost of " African guns " versus " Park Paling."

	£	s.	d.
Common musket barrel, or birding barrel	0	2	0
Lock	0	0	4
Stock	0	0	4
Stocking	0	0	5
Brass furniture . . .	0	0	3½
Screwing together, and finishing .	0	0	9
Polishing and hardening, hammer, &c.	0	0	4
Steel rod . . .	0	0	3
Browning and painting barrel and stock	0	0	4
Small items . . .	0	0	3
Total, . . .	£0	5	3½

You can have a shipload of these for 5s. 6d. each; it is satisfactory to know they send powder with them of *similar quality*.

We might dismiss this part of our subject, with out a further remark; but in doing so we might think ourselves blameable in not stating in even these low priced articles we are beat, not that the

Belgians produce rubbish equally bad, they do not, as will be understood, when the chapter on proving has been read ; they have guns equally low in price, *not lower*, but, then thanks to the proof system, they are safe. Here is a vast field for thought ! What will be the ultimate result ? banishment from all our foreign markets, cut out by our competitors. Their guns do not burst like your English guns says the foreigner, we can buy them at the same money. Political economists interfere, say we.

CHAPTER VI.

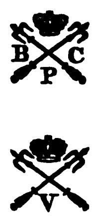
THE PROOF OF GUN BARRELS.

For a considerable period subsequently to the introduction of the manufacture of gunnery into England, there existed no public proof, or test, for the goodness and safety of barrels, further than, that the feeling of the maker induced him to protect the limbs of his customer;—even so early as the seventeenth century, the bad bias of human nature began to be displayed in the production of materials, the use of which was attended with loss of both life and limb.

In consequence of the prevalence of the bursting of inferior guns, the Company of Gunmakers of the City of London instituted a proof-house, at which the barrels of respectable makers were all sent to be proved, in addition to the example of the East India Company making all their muskets undergo the same test, and it thus became a custom, not only to have barrels proved there, but many underwent an extra test on the premises of the manufacturer, so jealous were sportsmen, and so necessary was it deemed to provide against any possibility of accident; showing clearly that laws are not always required to carry out certain results, but that it is sometimes preferable to allow matters of this kind to be arranged according to the knowledge of the party interested, for frequently when an individual is aware that there is a law under which, in case of need, he can shelter himself,—as many do at this day in case of guns bursting,—he becomes careless, having always a ready answer, "I can assure you the barrel was proved, and there must have been some unfortunate cause for her going—you must not have rammed the wadding home, or you must have had in an extra charge," and such like observations;—never for a moment doubting that there was any insufficiency in the proof. The great demand for rubbish of a villainous description during the existence of the slave trade, induced some philanthropic gentleman, (or, more probably some speculator,) to

found a company, with suitable premises for the proof of all gun barrels, and for which an act of parliament was obtained in the year 1813, incorporating the body. The first act proved insufficient, as the Birmingham makers found easy means of evading it, and they had to obtain a fresh act in 1815, by which parties receiving any barrel to rib, stock, &c., without its having previously been proved, became liable to a penalty of twenty pounds, and not less than twenty shillings; it also enacted that any person or persons making and selling any gun, the barrel of which had not been proved at either this or the London proof-house, became liable to the same penalty; and it further enacted, that any person or persons forging the stamps or marks of either of the two proof-houses, should be liable to the same penalties, and in default of payment, a certain term of imprisonment, &c. It also ordered, that all barrels be proved with the quantity of powder in proportion to the various bores enumerated in the table in the following page.

LONDON MARKS.



BIRMINGHAM MARKS.

PROOF SCALE.*

Number of Balls to the Pound avoir.	Weight of Powder for Proof.	Number of Balls to the Pound avoir.	Weight of Powder for Proof.	Number of Balls to the Pound avoir.	Weight of Powder for Proof.
	oz. drs.		oz. drs.		oz. drs.
No. 1	11 0	No. 18	0 12½	No. 35	0 7
2	5 5	19	0 11	36	0 7
3	3 8	20	0 10	37	0 7
4	2 11	21	0 10	38	0 6½
5	2 2	22	0 9	39	0 6⅓
6	1 12	23	0 9	40	0 6⅓
7	1 8	24	0 8½	41	0 6
8	1 6	25	0 8⅓	42	0 6
9	1 2	26	0 8½	43	0 6
10	1 1	27	0 8½	44	0 6
11	1 0	28	0 8⅓	45	0 5⅓
12	1 0	29	0 7½	46	0 5⅓
13	0 15	30	0 7⅓	47	0 5⅓
14	0 14	31	0 7⅓	48	0 5⅓
15	0 14	32	0 7½	49	0 5⅓
16	0 13½	33	0 7	50	0 5⅓
17	0 13½	34	0 7		

* In addition to the above scale, we will add one which will convey, at one view, the diameter of the ball and weight of powder and lead.

We have added the diameter in decimals of an inch, weight of powder and ball in inches.

DIAMETER OF THE BORE AND WEIGHT OF POWDER AND BALL IN OUNCES.

No. of Balls to the Pound avoirdupois.	Calibre of the Bore in Inches.	Weight of Powder for proof in ounces avoirdupois	Weight of Ball for proof in ounces avoirs
No. 1	1,69	11,	16,
2	1,341	5, 312	8,
3	1,172	3,5	5,33
4	1,064	2,687	4,
5	,988	2,125	3,2
6	,930	1,75	2,66
7	,883	1,5	2,285
8	,845	1,375	2,
9	,812	1,125	1,77
10	,784	1,062	1,6
11	,760	1,	1,45
12	,738	1,	1,33
13	,719	,937	1,23
14	,701	,875	1,142
15	,685	,875	1,066
16	,671	,818	1,
17	,657	,818	,941
18	,645	,756	,88
19	,633	,687	,842
20	,623	,625	,8
21	,612	,625	,761
22	,603	,562	,72
23	,594	,562	,695
24	,586	,531	,66
25	,578	,531	,64
26	,570	,531	,615
27	,563	,531	,592
28	,556	,531	,571
29	,550	,468	,551
30	,544	,468	,53
31	,537	,468	,516
32	,532	,468	,5
33	,527	,437	,48
34	,521	,437	,47
35	,517	,437	,457
36	,512	,437	,44
37	,507	,437	,432
38	,503	,436	,421
39	,498	,406	,41
40	,494	,406	,4
41	,490	,305	,391
42	,486	,375	,38
43	,483	,375	,372
44	,479	,375	,36
45	,475	,373	,35
46	,471	,343	,347
47	,468	,343	,34
48	,465	,343	,33
49	,462	,343	,326
50	,550	,343	,32

On the quantity of powder described in the foregoing scale, is put a leaden ball to fit the bore, but previously placing on the powder a roll of paper, and then expanding and filling the bore with this paper, by striking a few sharp blows with a heavy copper rod, this being calculated to increase the friction, and lengthen the test during the explosion.

"As soon as a number of gun barrels are loaded according to the foregoing scale, they are taken to a house or detached building, standing apart from other offices. The house is lined throughout with thick sheet iron. (The woodcut at the head of this chapter represents the interior accurately.) The windows, which resemble Venetian blinds, are constructed of the same metal. Iron frames are laid the whole length of the room; on these the barrels of various qualities, when about to be fired, are placed. In the front of these frames lies a large mass of sand, to receive the balls. Behind the frame, on which the twist barrels are fixed, lies another bed of sand, in which, on the recoil, the barrels are buried. Behind the frame, on which the common barrels or muskets are tried, a strong iron bar is placed, having a number of holes large enough to receive the tang of the breech, but not the barrel. The barrels being thus fixed, it is impossible for them to fly back. A groove runs along the whole length of each frame, in which the train of powder is strewed to ignite the charges, upon which

the barrels, with the touch holes downwards, are laid. When every thing is ready for the proof, the windows are let close down, the door is shut and secured; an iron rod heated red hot, is introduced through a hole in the wall. On touching the train, a tremendous explosion takes place. The windows are then drawn up, the door opened, the smoke dissipated, and the twist barrels are found buried in the sand, the common ones are thrown forwards—some are found perfect, others burst to pieces. It is rare that best barrels are found burst—more frequently bulged or swelled out in places which are faulty, or of a softer temper. Those that are found perfect, are then marked with punches of different sizes (but having the same impression,) according to the quality of the barrel. In London, they have an additional punch, containing the number of the bore the barrel has been tried by. This mark easily enables the observer to discover whether the barrel has had any considerable quantity bored out after proving, which the marks of the Birmingham proof-house do not; the omission of which, except to a person well versed with the different sized punches, is a disadvantage. Those that are bulged are sent to the maker who beats down the swellings, sends back the barrels, and they are proved again. They generally stand the second proof, though we have known a barrel undergo four proofs before it was marked. The common barrels are required to

stand twenty-four hours before they are examined, when, if not burst, any holes or other material imperfections are made quite apparent by the action of the saltpetre. Such barrels are, of course, sent back unmarked. Those that are found satisfactory are duly stamped and taken home.

"We object to the practice of allowing best barrels to rebound into a body of sand. This is a practice calculated to destroy the efficiency of the test to the extent of at least 50 per cent. Gunpowder explodes with equal force in all directions It necessarily follows that on firing a loaded barrel, the force of the explosion is equally exerted on the breech, the charge of lead, and the side of the tube.

"If we suppose the tube to oppose a firm resistance to any escape of an explosive force in that direction, the force is driven by its elasticity to find vent in any direction that is easiest. Of course, then, the force is exerted on the charge and on the breech, and the barrel is thrown back as far, in proportion to its weight and the resistance that it meets with, as the ball is projected forward. If, however, the barrel were fixed, as common barrels are, the explosive force, meeting with as firm a resistance from the breech as from the sides of the tube, would be entirely expended in the projection of the charge, and on the sides of the tube. Supposing that it requires a force of nearly 1400 pounds to

the inch to move the charge for the first inch, it follows that there is the same pressure on all the parts of equal surface. The breech being fixed, the force is driven back on the barrel and the charge of lead!—it follows, as a necessary consequence, that the pressure on the charge and the sides must be greatly increased. For instance, we will compare it to a man's strength. If he place himself against a wall, as a support, he can move a greater weight with less exertion, and more effectually from him than if he were to stand unsupported, or against a support that gave way as he leaned against it.

"It is the same with a gun barrel. If the explosive force of the powder can escape in two ways, it will not drive both substances near the distance it would drive one, were the force properly concentrated on that one.

"We will explain how we first became satisfied with the truth of this fact. We took an old English barrel very small in the bore. Into this were fitted two plugs, each, one and a half inch long. Our first purpose was to ascertain which description of patent breech was calculated to destroy the recoil most effectually, and then, of course, which would increase the strength of shooting most. Half-way up the barrel, we put directly across the bore two wire pins, so that we might be sure each breech was in its place. It will be understood that they were not

screwed in. They were merely made to fit the bore, as a ball might be and cupped out in the same manner as patent breeches are, only that the chambers were of different patterns. To ensure the same degree of force acting on each, the touch-hole was drilled as near the centre of the two as possible. Having put in the breeches and the powder, on the application of a hot iron the explosion took place, and we found one breech blown 18 yards, the other 32 yards. We then reversed them, lest there might have been any inequality, and we found the result as before; the one being projected to the distance of 33 yards, the other 17½. We repeated the experiment until perfectly satisfied of the superiority of one over the other. We next secured one of the plugs by drilling two holes; one through both the barrel and breech, and one directly behind it, through which were put two very strong iron pins, and otherwise secured it, to prevent a possibility of the explosion moving it. We then put in the same quantity of powder and the breech that had before been thrown furthest, and having secured the barrel against a stone, it was fired as before. The breech was projected to the distance of 73 yards; thus proving the advantage of firmly fixing the barrel, the projectile being thrown 23 yards further than the two together were before."

There was proved at the Birmingham proof-house

during the last year, the following enormous quantity of barrels:—*

Twisted barrels . . .	50,000
Large barrels . . .	500
Common iron barrels, including musket and fowling-piece barrels .	180,000
Twisted pistol barrels . .	2,000
Common pistols . .	4,000
Saddle pistols . . .	13,000
Total,	249,500

Taking these at an average of fourpence each, here is a gross amount of £5,107 : 9s. 4d. yearly—an excellent income, indeed; the current expenses may be £1,000 a-year, say £1,200, and thus you have a clear total of £3,907: 9s. 4d. a-year to share amongst the fortunate holders of Proof Company's Stock. How can it be that such a state of things is allowed to exist? We cannot wonder, indeed at the supineness of the Company allowing either forging or any other evasion of its rights, the snug income of £4,000 a-year is so easily obtained, that men can always sit *comfortable* under such overwhelming blessings.

* This statement is not official, as we had no answer given to an application for information at head-quarters, therefore we were obliged to obtain particulars as we best could; but we have reason to know that the accompanying statement is pretty correct.

The manufacture of inferior guns is thus encouraged, for it yields an enormous return to the coffers of the proof-house. Any other arrangement—any real improvement in the severity of the test, can never be expected so long as this monopoly is allowed to exist. There is good reason to believe that the inferiority of the test best barrels are subjected to, is but a *sop* to the trade, or a benefit, probably, to the wardens* themselves, in common with the rest of the profession. But this is only another argument for some more effectual establishment, as the impotency of this must be quite apparent and notorious; and as long as it is allowed to tax the trade in the way it does, there will be little heed taken how the *cat jumps*.

The London Proof Company also prove a considerable quantity of barrels annually; but, with the exception of the barrels of the East India Company's muskets, twist barrels are the principal. Their rules require double barrels to be put together and breeched, before they will receive them for proof. To show clearly that self interest is at work, we will instance the rescinding this most excellent rule, barrels can now be sent singly, if breeched, and flattened on one side to give an appearance of jointing, which in reality never takes place, in 99 cases

* The wardens are generally chosen from the body of shareholders who are gun-makers. We know none of them, we speak generally, and mean nothing personal.

out of 100 the barrels are ground down at least 30 per cent. after proof.

Full thirty thousand twist barrels are annually sent to the Whitechapel proof from Birmingham alone: the quantity sent by the London makers may average four thousand, and these only the very best. The great supplies from Birmingham are intended mostly for the London sale shops, in addition to what direct orders are given to the former: the only advantage derived from this practice is, that it enables the seller to warrant it a town-made gun—only an imaginary benefit, for any real utility there is not, as one is *quite as good* a test as the other, though, to speak candidly, neither is worth a jot.

That some steps must shortly be taken to effect a reform in the proving of guns, we have no doubt, for the laxity displayed in both places has become so great as to imperatively call for an alteration: it is a startling announcement, but we stake our reputation upon it, that there is not more than 10 per cent. of the guns made in England safe, nor would in reality stand the proof, after being finished, solely and entirely owing to the fact of the present system allowing the barrels to be sweated, and reduced to an enormous extent; it is a lamentable fatality and will eventually destroy our export trade, the consequence is that iron of the most inferior nature, the veriest *rubbish* is used. They have only to send a

barrel 5lb. weight to proof, it stands, and is marked; off it then goes to the mill and is bored, and ground until it is not 3lb.; to call this proving is a mockery, it is a deception, an act of the *grossest* dishonesty to be charged upon the cupidity of the proof companies, for both establishments are as well aware of the nearly universal practice as we are. We appeal to the conviction of any man, have we charged them undeservingly? every limb or life lost, is on their heads. But not only in a moral point of view are they culpable, but this practice as we before stated will be the means of depriving us of our export markets by the "*Liegeoise.*" Their proof is good, be it a gun costing 5 francs or 500, both must undergo 2 proofs, one in the rough state, one in the finished, so that if the cupidity of the makers induce them to attempt our English practice, why he is punished by having the barrel or barrels burst The penalties for non-proving, or forging the marks is much more severe than with us, and if repeated the party is prohibited from manufacturing guns again. Nor does the goodness of their arrangements cease here, the cost of their two proofs is only on the average about 1½d. while we pay on the same scale 4½d. The Belgian proof is managed under the controul of the government, and hence the "paternal" care, showing most clearly the interest they take in advancing the interests of their subjects.

We will just instance the proving of the govern-

ment arms, as a further convincing proof how they view the matter. Every musket, carbine, rifle, or pistol barrel undergoes at the tower and at their establishment at Birmingham, two proofs, one rough, the other when finished. But we have felt it to be our duty previously to this, to address a letter to the trade especially, and for the good of the general reader, we have reprinted it whole, and it will be found in the appendix.

We have seen more burst *plated* barrels at the London house than ever we saw in the other. We have seen a batch of fifty barrels sent at once for one house in London *all plated;* and strange—but the same house has added gun-maker lately to its other designations; and yet sportsmen are found who patronize such individuals.

Many complaints are made by barrel makers, that there is not the same degree of partiality shown to all by the proof-masters. Some say, their barrels are sent back as bulged, when nothing is the matter with them, because they object to stand a certain periodical bonus. We are, not aware whether such is the case, but we believe it may be true; and it adds more weight to the argument for abolishing the monopoly. Government is the proper party to take the management of an affair of so much importance to the whole community; and they are building premises in Birmingham for the manufac- of fire arms, they would be able to conduct the busi-

ness economically and beneficially to maker and purchaser, at the least possible cost; but, in short, cost is a matter of very minor consideration, when contrasted with the extra safety obtained. An arrangement of this nature will some day be accomplished, for it is preposterous for the present to continue without amendment.

Whatever might have been the original intention of the founders of the proof corporation, it is now quite evident it has settled down into a profitable speculation, a means of inflicting a tax upon the public, without a commensurate benefit. We doubt at all times, the justice of delegating to any men, the extensive powers that have been given to this body; for the invariable consequence is, circumstances so affect subsequent arrangements as frequently utterly to destroy any ultimate good that may be derived, in addition to the clogging of energies by the friction of restriction. We argue not for no proof, but we argue that individuals should not be allowed to draw a revenue from any trade, if they do not yield a fair return for that benefit, and also, that the original intention having been obtained of having a proof, one farthing more should not be charged than is adequate to meet the current expenses, for here is clear evidence that the high charges is a preventative to barrels being proved, for no one can imagine for a moment a barrel filer will pay to the proof house twenty per cent. tax, upon the article he ma-

nufactures; he pays that if he pays at all, for a barrel that is sold for 1s. 9d. has paid 3d. for proving; can any one be expected to believe this, with the small penalty that is attached to the offence acting as the only stringent. No, thousands of barrels are yearly made which never see the proof cellar at all. What cares a Birmingham man about a twenty pound penalty; it is the royal mint to a *China orange* in his favour, very few convictions take place, and when they do, it is only in nominal amounts. The gunpowder used is of a very inferior description indeed, when compared with sporting powder, the very powder all sporting guns are to be used with is nearly three times the power of the proof powder.

For taking Hutton's calculation that gunpowder explodes with a velocity of five thousand feet per second, bear in mind he means government best powder, you have a material not exceeding one third the velocity possessed by the best canister powder, for it is indisputable that the latter explodes with a velocity of full fifteen thousand feet per second, as the next chapter will go far to prove; the pressure of this will be in proportion; compare the resistance of 1½ ounces of shot, a body capable of being *jammed* together, and thus exerting a lateral pressure of the greatest extent; with the lateral friction of two rolls of paper, and a solid ball, not capable of any lateral expansion, and barely all weighed together, equal to two thirds the weight of the charge of shot, and the

great dissimilarity becomes glaringly apparent. The proof powder is only of a similar strength to that of Hutton's calculation, and quite unfitted for the purpose. The generality of barrels that do burst are all rent in the fore part, all guns that burst with shooting, burst near the breech, we do not say all, but a vast majority. This is in perfect keeping with all our remarks; for, in sporting, the greatest test is in the first lift of the charge; in proving, the greatest test is in the mid distance from breech to muzzle, and so arises the result.

The proportion of guns that are broke (they technically call bursting *broke*) in proving is very small, not exceeding three to four per cent. This we also applied to head quarters to know, but like the answers to the other questions, we were left to guess at them. The largeness of the grain of the powder is at too great an extreme, no doubt it is beneficial to have larger than the present sporting scale, yet here they have grain large enough for a duck gun, instead of appropriating it to the various purposes wanted. Pistols are crammed nearly full of powder, with not an inch of tube for the ball to travel through, nor the slightest extra pressure obtained; why, it is one of the greatest pretences without reality we know of, and only a blind for the ignorant.

CHAPTER VII.

ON THE SCIENCE OF GUNNERY.

"Science begins at the point where mind dominates matter, where the attempt is made to subject the mass of experience to the scrutiny of reason. Science is mind brought into connection with nature."—COSMOS.

THE science of gunnery, on the large scale, owes a great deal to the ability of Robins and Hutton; for the manner in which the two simplified the principle, has left their names coupled with it in a way which never can be entirely forgotten. Previously to the researches of Robins, the theory of atmospheric resistance was but imperfectly surmised, and when he made his statements of the immense resistance the fluidity of the air offered to projectiles in a high state of velocity, they were treated as the

idle chimeras of a speculative brain, and yet he only was enabled to estimate the real effects of the explosive nature and force of gunpowder to a very limited extent; indeed, so limited that Hutton, only twenty years subsequently, speaking of Robins' theory, says, " Mr. Robins and other authors, it may be said, have only guessed at, rather than determined. That ingenious philosopher, in a simple experiment truly showed that, by the firing of a parcel of gunpowder, a quantity of elastic air was disengaged, which, when confined in the space only occupied by the powder before it was fired, was found to be near 250 times stronger than the weight or elasticity of the common air. He then heated the same parcel of air to the degree of red hot iron, and found it in that temperature to be about four times as strong as before; whence he inferred, that the first strength of the inflamed fluid must be nearly 1000 times the pressure of the atmosphere. But this was merely guessing at the degree of heat in the inflamed fluid, and, consequently, of its first strength, both which in fact are found to be much greater. It is true that this assumed degree of strength accorded pretty well with that author's experiments, but this seeming agreement, it might easily be shown, could only be owing to the inaccuracy of his own further experiments, and, in fact, with far better opportunities than fell to the lot of Mr. Robins; we have shown that inflamed gunpowder is about double the strength

that he has assigned to it, and that it expands itself with the velocity of about 5000 feet per second." On the same subject he further says, "On this principle it was that Mr. Robins made all his experiments and performed all his calculations in gunnery. But it is manifest that this method of guessing at the degree of heat of the flame must be very uncertain and unsatisfactory, being much below the truth, since all our notions and experience of the heat of inflamed powder convince us that it is higher than that of red hot iron, and, indeed, it has clearly appeared from our experiments, that its heat is at least double that of red hot iron, and that it increases the elasticity of the elastic fluid more than eight times." Here is evidence, and yet not conclusive, of the immense force of gunpowder, and also of the progress of knowledge on the subject; yet it clearly shows the evil of coming to hasty conclusions, however well supported by apparent facts, as it has had in this case a tendency to check enquiry, and retard the advancement of knowledge. For the extensive experiments of Hutton were but limited in discovery, because they were not carried to a sufficient extent, and thus, they are quite unsuited to the present day; he was satisfied because he had gone further than any of his predecessors, and though he established and clearly proved the soundness of his own theory, yet he could not either see the subject to its utmost bounds, nor yet go

sufficiently far, but that others, taking up the question where he left it, may pursue the subject to a much more remote limit. The subject to him was limited. He far excelled Robins, no doubt, as he has shown, but in that there is no detraction from the merit due to Robins for his experiments and discoveries, no more than any individual proving the subject to be a more extensive one than Hutton did, would excel Hutton, for the value of improvement is more to be attributed to him who lays the foundation, than to him who raises the building, so is it in this case, Robins laid the foundation for an extensive knowledge of the nature and power of the explosive fluids, and Hutton built upon that foundation a certain extent of superstructure, and there he left it, without roofing the building; expecting the question was settled. However, common consent has, as yet, received his conclusion as unshaken and uncontroverted, nor is it our intention to make the attempt, but rather to show that his deductions are short of what the principles of gunpowder permit, carried out in the more extensive way they have been done within the last few years. The limited nature of his experiments. This is rather an extensive position for us to occupy, or endeavour to hold—but we do not mean the size of the *tools* of *experiment* so much as the diversity of them, for exploding ten thousand tons of powder in the same machine and in the same way, would but give the

same, or similar results; it is the variety and the singularity of experiments that expands and enlarges the fund of knowledge, and enables the mind to conceive and comprehend the immensity of the power and velocity of this wonderful combination. We have been principally indebted to the exertions of the chemist, for means of purifying and extracting from the ingredients, which form this astonishing compound force, the impurities and foreign substances, which exist, to a certain extent, in all the three, and thus tending to form a more perfect combustion by increasing the affinities.

Hutton shows that gunpowder is but so much condensed air, for he says "We may hence, also, deduce the amazing degree of condensation of the elastic air in the nitre and gunpowder, and the astonishing force experienced by its explosion. It has been found by Mr. Robins, and other philosophers, that 3-10ths of the mass of the powder consists of the pure condensed air, or that the weight of the condensed air is equal to 3-10ths of the whole composition. But the whole composition of the powder consists of eight parts by weight, of which six parts are nitre, one part sulphur, one charcoal; of which the nitre or 3-4ths of the composition furnishes the whole of the condensed air, while the sulphur and charcoal only give the fire that produces the explosion. But 3-10ths of the whole mass of eight parts is equal to 4-10ths of the

six parts of nitre, that is 4-10ths or 2-5ths of the nitre consists of condensed air, or the weight of the gross matter in the nitre as four to six, or as two to three; and these two parts, it is probable, are of equal density, or specific gravity. Yet the specific gravity of nitre is 1900, that of water being 1000, and of air 1·2, which is contained in 1900, as much as 1583 times; that is, the air in the nitre must be condensed the amazing quantity of 1583 times, if its specific gravity be equal to the compound nitre itself." Also, "The air is condensed in the nitre about 1600 times, nearly double the density of water, which may well be considered as probably the greatest degree of compression that air is capable of. Hence it may be perceived that a prodigious force must be exerted by nature in generating nitre, and as this great force actually exists in nature, it is very probable that the air in the nitre is thus compressed into the most dense state possible, and in this consists the similitude among the different particles of nitre." This extract from Hutton enables us to divest the question of any technicalities and puts it in so plain a garb, that the simplest mind may comprehend. Now, the great improvement of chemistry has been to extract from the nitre the gross material which is contained in the proportions—2-5ths impurities, and 2-5ths condensed air; thus, half the quantity being useless, the extraction of these alloys gives a greater quantity of condensed

gases in the same quantity of matter; for if we take away 2-5ths of the proportions of useless matter, and supply its place with 2-5ths more condensed air, we thus get 4-5ths explosive matter in the same bulk of material, and thus simply obtain an immense increase of power, without an increase in bulk. We have here the progress that has been made in the science of explosive force.

Considering the difference between gunpowder in 1783 and gunpowder in 1846, we cannot say, with Hutton, that the force is doubled now to what it was when he wrote—we repeat, we cannot say this positively; but we believe it is not far from the truth did we say so; for it must be quite clear, if he is correct, which we know he is, in saying the force of gunpowder consists in the quantity of explosive matter let loose and expanded by heat; that the greater the quantity of condensed matter we may have in any given weight, the greater the force, and the more rapid the explosion: purified saltpetre thus forming nearly pure gaseous matter, as the diamond is pure carbon. It seems singular, and is rather a presumption to say, that Hutton was not much of a chemist, or he must have perceived that, in the extraction of the foreign matter from the nitre, existed the means of obtaining an increased quantity of explosive power, and a proportionate increase of speed or velocity in that explosive material. If he had but seen a possibility of this, he

must have paused ere he set limits to the velocity of projectiles, and setting bounds to the development of the extensive discoveries yet clothed, like the gem, in a coat of obscurity.

Dr. Ure states, "Government purify their nitre in a way that cannot be surpassed:" if so, how is it that military gunpowder is so far inferior to the powder manufactured for sporting purposes? they must use less nitre, or the process must be inferior in some of the manipulations, as it is sufficiently well known, powder stronger than usual is rejected by their receivers as unfitted for military purposes.

Next to the expansive force of the explosive fluid, is the velocity of that expansion, and a true conception of this principle will lead to the understanding clearly the whole science.

The elucidation will be aided by this additional quotation from Hutton:—"It remains now then to determine the velocity with which the elastic flame expands itself and moves. If the whole substance of the powder was changed into an elastic fluid at the instant of the explosion, then, from the known elasticity of this fluid, deduced from our experiments in the foregoing articles, and its known density, we might determine the velocity with which it would begin to expand, and could thence discover its future augmentations in its progress through the gun cylinder. *But as it is probable* even that the powder does not *inflame all at once*, and it is certain

that the greatest of it, namely, 7-10ths, co.
gross matter not convertible into an elastic
which matter will, in the explosion, be mix
the elastic part, and by its weight retard the a
of the explosion,—and yet they will not be s
formly mixed and intimately united as to be n
with one common motion, but the gross part
be less accelerated than the elastic, and some
will not even be carried out of the barrel, as app
by the quantity of unctuous matter which adhe
to the inside of all fire arms after they have been discharged."

Here is a clear exposition of the inferiority of the gunpowder of his experiments, and the improvement, it will be easily seen, is obtained, as already mentioned, by the extraction of a large portion of the 7-10ths gross matter, and the substitution instead of an additional quantity of explosive material, clearly showing the extent of the improvement in force and velocity. The velocity of his experiments is thus explained. After detailing a number of his own results, he says: "But by an experiment of a different kind, Mr. Robins found the velocity of the flame come out as high as 7000 feet per second, which is probably nearer the truth, as we suspected before making the computation." It is difficult to reconcile the incongruity of this, if we recollect that Hutton claims the merit of finding that powder is of double the expansion allotted to it by Robins,

and yet afterwards takes his conclusions of the velocity of gunpowder as "very near the truth," and the year before states 5000 as the maximum velocity. It is of trifling consequence, as we shall clearly show, that even the highest calculation is under the actual velocity, that the explosion of sporting powder is vastly more rapid and powerful than at all conceived by the great mathematician, this will not be so difficult a task as may be imagined, for it is obtained purely by chemical improvement, and the mechanical arrangement of granulation combined. Cleanness, the want of unctuous deposit, is the best proof of good gunpowder, as it shows an absence of inferior substances, gross or foreign material, and enables us to estimate the explosion at its greatest velocity, from the absence of this adulteration. The system of granulation forms into an immense number of bodies a certain quantity of explosive material; the ignition of the whole quantity will be lengthened or shortened as the grains shall be large or small; the interstices being in quantity as are the grains, the intensity of the exploded fluid finds a path and penetrates through the mass, from the great immensity of the number of the interstices, and each grain is nearly simultaneously ignited, and is burnt to the core, generating all the explosive gas in a comparatively short period. The interstices amidst the large grain are of greater extent, and each grain is inflamed equally as quick as

the smaller, but the duration of production of explosive matter is as to their size, being a firm compressed body, (remember the action of Bramah's press in manufacturing;) the outside has, of necessity, to burn first, and is thus gradually consumed to the core, the duration of time being exactly as is the difference of size between the large and small grain—it is necessary to understand this clearly, or all the remaining explanations will be imperfect; therefore let it be firmly understood, as it cannot be disputed, that on the fineness of the grain of powder depends its quickness, if these grains are perfect grains of a given density and hardness: for we have before stated, that mealed powder is not quick in its explosion, from the want of interstices, or paths, for the flame to travel through; and also, that the duration of an explosion, or the period during which a continuous generating of force is obtained, is dependent upon the size or quantity of matter in each individual grain: if the density and firmness of body is equal to the former, for a grain of powder is condensed similarly to the composition in a sky-rocket, which is required to burn on a graduated scale. This, then, is another improvement in gunpowder since the time of Hutton.

Our experiments are, like Robins's, on a small scale, nor would we, like Hutton, try a brass gun of sixty calibres, carrying a one pound ball, for one is

strictly more limited than the other, and thus rendered the results laid down by him imperfect; for as he says, "if you fill the tube with powder you get no greater velocity, as there is not a duration in the confinement to enable the powder to explode." If he had assimilated the grain of his powder to the gun, he would have obtained a different result, and a knowledge of this fact, we apprehend, makes all the difference. The greatest velocity he obtained was with 1½ times the weight of ball in powder in a gun of sixty calibres in length, and the velocity he then obtained was only 3181 feet per second; and what probably induced him to conclude himself, and recommend others not to endeavour to obtain a greater velocity than 2000 feet per second, was, like these experiments, drawn from imperfect data. With a ball of an ounce weight in a barrel of sixty calibres, and with 3-4ths the weight of ball in powder, or 12 drachms, a velocity can be given to the ball to equal it in force to 46,875 pounds. The velocity of this ball we leave to the calculations of the mathematical world: were we to give a definition of that velocity, we might be imagined on our road to Hanwell asylum. But, however, we will give the results of a round of experiments tried to ascertain this, and if the data laid down, that the velocity of a ball must be multiplied by its weight to find the force, the result will be the establishment of a system of velocity never yet dreamt of. We

cannot but imagine that there exists some error, but where it is we know not; every deduction we have drawn is consequent upon the results hereafter described.

From an extensive round of experiments made by Mr. Joseph Colthurst, and laid before the Institute of Civil Engineers, it appears that there is a scale of force necessary to punch holes of a given diameter through plates of iron and copper of a given thickness, as follows:—

"The power required to force a punch 0·50 inch diameter through an iron plate 0.08 inch thick is 6025 pounds, through copper 3938 pounds. A simple rule for determining the force required for punching may thus be deduced:—

"Taking one inch diameter, and one inch in thickness as the units of calculation, it is shown that 150,000 is the constant number for wrought-iron plates, and 96,000 for copper plates.

"Multiply the constant number by the given diameter in inches, the product is the pressure in pounds which will be required to punch a hole of a given diameter through a plate of a given thickness."

Now an idea struck us, that this would form a very good test of the comparative force of gunpowder, and we consequently commenced an extensive round of experiments.

In the first attempt we found the results to vary with the weight of the pendulum of iron plate, and found it necessary to obtain a uniformity of size and surface, as it must be comprehended that the only resisting medium to the pendulous plate was atmospheric resistance, and a dissimilarity of size of surface would invariably give different results. Having a number of plates of the different thicknesses hereafter described, we continued increasing the charge from a definite quantity, until the projectile was driven with sufficient velocity to perforate the plate suspended. The gun selected for this purpose was of ponderous material, weighing near seventeen pounds, three feet long, having the metal of the barrel as thick at the muzzle as at the breech, carrying a ball of sixteen to the pound, or one ounce, and which fitted tight with the thinnest patch procurable. The bore perfectly cylindrical, and plain inside, being polished longitudinally to a high state of fineness. With a charge of twelve drachms of Curtis and Harvey's diamond grain powder, the ball went through the half-inch plate, but going only a few yards further, denoting that the effort necessary had nearly exhausted its velocity and momentum.

The recoil of the gun was of the most severe description, and the shoulder had to be protected for many explosions previous to this high charge. The larger sized grain was insufficient, ten drachms effecting the greatest extent of power it seemed

capable of, and it became quite apparent that the tube would not explode more, as indications convinced us—when any more was added, a portion came out unburnt.

The force necessary to effect this, by the above calculation, is 46,785 pounds.

The next plate was 7-16ths thick, and a charge of ten drachms punched the piece out clean; nine and a half drachms were equal to it, when the centre of the pendulum could be hit fairly, arising from an equal resistance from the atmosphere, which cannot exist in cases where the edge of the disc receives the blow.

We got with ease a perforation in a 6-16ths plate, with a charge of either fine or coarse powder, not exceeding eight drachms; a charge of seven drachms of fine grain was unequal to the task; but seven drachms of the coarse showed evidently greater effects produced, though the perforation was not perfect. Six and a half drachms of No. 2 grain penetrated a plate of 5-16ths thick easily, while it took full six and three-quarters drachms of fine grain; five drachms of the larger perforated a quarter-inch plate, but it took full five and a half drachms of fine grain to effect the same; while a 3-16ths plate took three and three-quarters drachms of fine, and three and a quarter of No. 2 grain; and 1-8th plate was easily punched by two and a half drachms coarse and three drachms fine. We will

place the relative results in a table, with the force effected by each.

1 oz. ball,	12 drachms of powder.		Punched a boiler plate Half-inch thick.		Equal in force to 46,875 lbs.
1 ..	10	do. ..	7-16ths	do.	41,015
1 ..	8	do. ..	6-16ths	do.	35,155
1 ..	6½	do. ..	5-16ths	do.	29,295
1 ..	5	do. ..	4-16ths	do.	23,437
1 ..	3½	do. ..	3-16ths	do.	17,578
1 ..	2½	do. ..	2-16ths	do.	11,718

Were we to adopt the established method of calculation, multiplying the weight of ball by the velocity, we should get an answer that would point to the utter impossibility of any such velocity being possible. And yet the result is, according to the rule of figures, correct; but in truth there are exceptions to many rules, for they only are correct when applied to known products.

That the velocity of these balls is much, very much, greater than 7000 feet per second of time, there cannot be any doubt, nearly three times that. Yet we must not conceal the fact, that this punching is the more perfect, the higher the velocity, and shows how the fibres of iron are separated from a want of vibration to equilibrise the cohesion. Mr. Colthurst finds that duration of pressure lessened the ultimate force necessary to punch through metal, and thus it may be that extremely quick pressure may produce the same. Therefore we suspect it is not the most correct theory that calculates force to be accomplished at all times by extreme velocity,

there will be found discrepancies in the rule, and one of them arises from no calculation ever having been made with extreme velocities; medium velocities may generally give such conclusions, but the very extreme in this case can never have been taken into consideration at all, as we have much doubt, in fact, we are certain, no person ever obtained such high velocity before. It must, and is a vast deal greater, incomprehensibly greater than any velocity obtained by Hutton, and much more extensive than ever could be obtained, or, in fact, ever will, by any ordnance whatever. We were limited in means, or we would have experimented with a gun of greater length and bore, and in every way fitted for the purpose, we have no doubt of being able to perforate an inch thickness of plate; and should any person possessing the opportunity and means, wish to try it, we would advise them to get a barrel of 4½ feet long, 8 bore, to carry a 2 oz. ball, and of a weight to allow of extending the explosion up to 30 drs. of powder, they would then obtain the extent of force we have suggested. There is a certain point to be strictly observed, see that the plate you use is perfectly sound, for if laminated, or composed of various plates not firmly welded and attached, the experiment would be imperfect, for there would be an uneven vibration created, and, acting as the hammer held against the point of the nail when driving does, clinks the point, so does the substance in the portions

of plate prevent a perforation; an ounce ball, suspended against the back of the pendulum, by the jar or blow it receives and communicates, completely prevents the effect, and the ball is flattened, instead of perforating the object struck; so is it if you place a $\frac{1}{4}$ inch plate against any support. It thus has the power of perfectly resisting the force of the ball, though fired with considerably more force than is requisite under other circumstances. The effect appears to be chiefly mechanical, the outer fibres are driven in upon those behind them with such quickness that they lose cohesion, or are condensed quicker than the waves of vibration travel, thus giving them no means of communicating the vibration.* But when punched, the rapidity of their motion produces in the metal a sound of the most intense vivacity, which plays upon the ear for a considerable period, with rather a pleasant effect. Lead alone, is capable of being used in this experiment, except, of course, the precious metals, which it would not be *convenient* to use. Even an adulteration of the slightest quantity of solder is sufficient to prevent the result which lead, pure, will invariably give. Lead projected against lead, if sufficiently thick, cannot perforate, but the lesser portion becomes flattened; a cast iron ball fired against lead, with a certain velocity, is broken into pieces, affecting the lead comparatively little, showing beautifully the peculiarity of dense incompressible bodies, to resist most effectually, the

* See Babbage on vibration in the Appendix.

greater the velocity with which they are struck. Water will, if struck very sharply with the flat of a sword, act against the blow in a way to splinter the blade into pieces. The greater the velocity with which a ball is fired into water, the less the depth of penetration, thus showing clearly, the many excellent properties of dense incompressible bodies as projectiles, and proving that the objection of lead being too soft for artillery is without a foundation, and only entertained from a want of knowledge of its nature.

Considerable doubt exists as to the extent of heat generated during the explosion of gunpowder; a great difficulty having hitherto opposed itself, from a want of vessels to experiment with, and the means of confining the fluid the period of time necessary to enable the flame to develope its heat. The piece of barrel described under the head gunpowder, with a breech screwed into each end, and in which we have controlled two ounces of the finest grain powder, and that exerting considerably more than 2500lbs. pressure upon the inch square, we found it to be an implement which gave us means of ascertaining this, and from the length of time the powder takes in exploding, and escaping by the vent (nearly a second and a half,) afforded the means of the material acted upon, being subjected to the greatest extent of the action of the exploding fluid, and yielding the results expected, by melting gold,

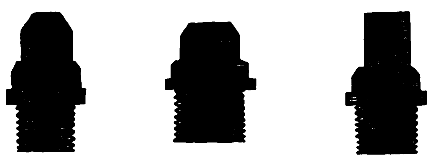
silver and copper wire effectually; if put in sufficiently thin portions, the smallest of wire was easily melted, but when it becomes nearly the size of bell-wire, the result is not so certain, both small and large grained power will do this; yet the period of time each is in escaping by the small orifice in the nipple is as their dimensions of grain. A considerable error may easily be promulgated, as to the heat necessary to be applied ere gunpowder will explode. A late writer says, it is necessary to raise it to 600 degrees before it is explosive. This is a splitting of hairs, and such a palpable mystification, that it is scarcely worth noticing; but we will explain; if you place upon a plate a few grains of powder, and by heating the plate underneath, for instance, on a smith's fire, you will see the sulphur giving out a blue flame, being easily fused. As the plate becomes heated to nearly a red heat, the whole explodes, (arising from the charcoal and nitre not being hot enough to allow the gases generating the heat to be liberated,) but as soon as this does take place the explosion ensues. Now, it is a well known fact, that the smallest particle of matter possessing above 600° of heat, will ignite any quantity of powder it comes in immediate contact with; we will suppose with one portion of charcoal, one of sulphur, and one of nitre, (it matters not how small they are, a ten hundredth part of the substance of one of the smallest grains of powder) and if it has the means

of communicating to these small portions, 600°, this is sufficient, as their explosion induces also that of the very largest quantity, as it ought to be perfectly understood, that a great explosion is but so many millions of small ones combined, and by their united force effecting the great results we see. The ingredients of powder are ground and intimately mixed together on the bed of the mill to the great extent they are, to the end, that in the composition there shall not, if possible, be two grains or portions of one ingredient in immediate contact with each other; but that, when the ignition does take place, each may be present to add its peculiar gas, that each affinity may be supplied, and so becomes evident the necessity of a most extensive incorporation, a blending and equal division of mixture throughout the whole material.

The advantage of unglazed gunpowder is here fully shown, for it presents an inequality, a roughness of surface, over which the flame from the percussion mixture cannot travel without igniting some of the prominent parts, and thus the whole. You may glaze powder and make it so smooth that it would be very difficult to ignite, indeed; but except that, it enables the powder to resist moisture better, it is otherwise very detrimental as tending both to prevent ignition and lengthening the period of effecting it.

The flame from the percussion powder is of that

intense and vivid discription, that if a charge of powder in the breech of a gun is loose, the flame will form a mass of condensed air round itself, and driving the grains of powder before it, prevent the immediate contact of the heat and the particles of powder, until the heat is expended, and thus arises a "miss fire." If the powder is up only to the nipple, there is a quantity of air in the tube of that nipple, and the explosion of the fluid will drive down this air, and condense it between the powder and top of the nipple to such an extent as to cause a certain "miss fire." It becomes requisite to find a remedy for this, and it can only be done by bringing the powder into the very vicinity of the explosion on the nipple. This can be effected in several ways, but the most perfect is to obtain as direct a communication as possible; a widening of the perforations of the breech, and space to allow the powder free access up the nipple; for this purpose we propose an improved form of nipple; the centre



OLD PLAN OF NIPPLE. NEWEST PLAN OF NIPPLE. IMPROVED NIPPLE OF 1836.

one of the three is considerably broader and shorter than the others; a cap made broader and not so

deep would be an improvement, as bringing the point of ignition nearer the charge, and thus effecting a saving of time; for great and wonderfully quick as is the explosion, it is clear to the senses that it may be quickened. We are not finding fault with the "lightning being too slow," as "the Colonel says," but science means perfection, and the nearer we can come to it the better, and thus improve the noisy, we had nearly said "the noble science."

We have before dilated on the peculiar properties of all fulminating mixtures. In all mixtures where the chlorate of potassa exists, there is the presence of an electric-like fluid, possessing none of the peculiar properties of gunpowder, save in the fact of igniting, yet of the greatest consequence, as being the most rapid conveying medium ever discovered. A considerable anxiety has existed as to the peculiar nature of Mr. Warner's discovery, which is to sweep from off the ocean all the splendid wooden cities that go forth to *fight the battles.* Old Neptune's favourites too, are to succumb to the laboratory of the chemist; research and science combined, are to say to those "wooden walls," "whose home is on the deep," be dispersed, and the infernal fluid undoes the mighty work of man, and the fragments are scattered "o'er ocean's broad expanse." Grand to the conception would be the effort of genius that could do this, but it can never be accomplished. A

vain and delusive conclusion has been formed from the result of limited experiments. A composition in which the chlorate of potassa forms a principal part, is the material to effect this wonderful, this great (only in the imagination,) exterminator of naval warfare. We feel confident that English feeling would despise the means, if ever it could be accomplished, for it leaves no chance for bravery and skill; all could be swept from the face of the ocean, "giving to whatever power is in possession of the secret, permanent controul over the seas." It will be found,—like all the chemical compounds that "have been going," to supersede gunpowder,—controuled and rendered comparatively useless by that simple fluid, the atmosphere. We can conceive the advantage of letting loose a thousand lightnings in the interior of a seventy-four gun ship; strong as she is, fractures would break into fractures, and the mechanically formed structure would be in splinters; but how convey that means, *not in the pocket*.

Years have rolled by, and still this wonderful secret remains in abeyance, if we except the experiment which led to the sinking of an old ship off the coast at Brighton. No doubt Mr. Warner succeeded in destroying the vessel; but the fact of his having had *communication* with the vessel, led to the general belief, that he held a connection by wires, ropes, or other means, and which fact has entirely neutra-

lized any impression effected upon the public mind. It must be clear to every unprejudiced person, that the whole value of the supposed invention, ceased the moment this belief was created. We would not for a moment detract from the merit due to Mr. Warner—if there be any—by saying, he actually held a communication, but the public think so, and so do we, and as long as that impression exists, so long will the world be dull to Mr. Warner's wooing. Nor did he mend the matter by subsequently publishing through the press, that he would destroy any vessel at *three miles* distance, by a *projectile.* The knowledge we possess of projectiles—either expellent as a cannon ball, or self-propellent as a rocket, points this out as a clear impossibility. For if an expellent, no practice, hitherto, would justify him in calculating upon hitting a ship oftener than *once in a thousand shots,* or if we expect the ship is on the alert, it is next to an impossibility to hit her once in ten thousand ; elevation, currents of air—in fact, the probabilities against the accomplishment of such a feat, are beyond the doctrine of odds ; while again, as a self-propellant projectile, is he no better situated, as here the chances are multiplied against him, as every artillerist knows. When he ignites a rocket, it may go straight forward, or zig-zag, or perform three-fourths of a circle, or return backwards to the rocket-frame ; so uncertain is it, and so great are the effects produced by the slightest

causes on its direction. Therefore if he be really in earnest, when he says it is a *projectile* he uses, we are willing to confess he must have *discovered* a projectile, or a method of projecting, which all the world have hitherto been ignorant of. If such be the fact, we cannot conceive how he should have overlooked this most important point; that the application of the principle to other purposes than the destruction of human life, must have remunerated him vastly more than this sanguinary purpose. How, if it be a discovery, that will cover a distance of three miles, *without any apparent explosion or visible means of expulsion*, why it must be a discovery applicable to the civil arts—if this be not so, there must be gross deception practised. Many of our chemical lecturers have declared they, one and all, could destroy the largest vessel ever constructed; give them but the means of communication, and we believe this, we could do it ourselves: but no one will venture to declare the possibility of doing this at the distance Mr. Warner states, and without such communication. The question arises, how is this? These individuals are perfectly conversant with all the known principles that rule science and mechanics, all knowledge hitherto disseminated, yet these men shrink from such an avowal; they know well, that all established principles must be upset to render success possible. It is also well known, that Mr. Warner is not a son of science, at least his

friends say as much of him; if so, who are entitled to belief, the many or the one? It is needless to advance the argument, that the wonderful discoveries of the present age justify us in believing nothing impossible. This is the most untenable assertion of all. Nothing has been accomplished of late years, but what is strictly in accordance with the established laws of nature and science. Even that bubble, the "Flying-machine," could be advocated, and proved to be akin to the projectile; but the *projectors* forgot how they were to get projectile force, and how to maintain it. We have frequently thought, they would have acted more rationally by saying, "We will apply the principle of the rocket to it." This combined with the other, would have been a grand conception, for it certainly is just within the bounds of possibility, that it might be accomplished thus. But a projectile to fly with unswerving accuracy three miles, with no apparent impulse, *is* impossible. The great discoveries in electric power, may point to a something yet to be accomplished; but if Mr. Warner's discovery be on this principle, we think he has allowed too much time to elapse without a developement of his plans; we doubt not such a result as Mr. Warner speaks of, may be obtained by the aid of "*Bottled lightning*," (*well corked*), thrown upon the waters. No question but the water would complete the galvanic circuit, and anything within its *vortex*, would be destroyed! Mr. Warner may have accomplished this, and brought

his bottling system to great perfection, but then he has committed a little mistake in pledging himself he would do such wonders by a projectile. Oh! no; it is no projectile—*it is concentrated bottled lightning*, at least nothing but this *can* answer. We have now a galvanic battery in action greater in power than any yet constructed. We have means of producing a greater body of electric fluid than has ever been obtained previously—we have applied it in many ways, and can conceive it possible to destroy any ship; yes, the largest ever built; but, we may calculate upon the means of "*bottling it up," into the size of an egg** as the discovery of the next century, certainly not of this.

The true science of gunnery consists in knowing that a certain force is requisite to effect a certain purpose, or, in other words, to kill at a certain distance, and how to arrange that force to effect the purpose without having any extra *force;* any waste of powder nor yet too little and yet a corresponding result; a sufficiency no more or less. This we have shown is attainable by the mechanical arrangement of granulation; for it is useless to use less, or to use an iota of more fine grain powder, if the size larger will effect the purpose without that iota. The velocity is the grand desideratum in all gunnery, the obtainment of this, to the greatest extent, is the power of killing at the greatest distance, all ranges

* Mr. Warner's friends say the power is contained in the size of an egg, and can be knocked about with impunity.

being dependant on velocity ; no *range* extreme can be obtained without a corresponding speed.

The very finest powder, it will be perceived, is fitted, perfectly fitted, preferable, indeed, to coarser grain for guns of a short length of tube, where a perfect combustion of the whole charge can be obtained without any waste or want, but as such is quite unsuited for longer barrels, we cannot too often repeat it. The column of air is the ruling power. Look what its effects are, by Hutton's calculations, with the very low velocities he obtained, so great as to bring all projectiles *he used* to a medium velocity, before they were projected beyond a certain distance ; then what must its resistance be where the velocities are trebled ; we say trebled ; for our powder, and the percussion combined, have more than trebled the velocities. You must then clearly have a powder of grain fitted to the capacity of your gun. All barrels have a size of grain that will suit them best, and manufacturers of gunpowder will consult their own profit, and the convenience of sportsmen, if they assimilate the grain of powder to various sizes, as in shot, to No. 1, No. 2, 3, and so on ; eventually this system must be adopted.

It will be seen quite clearly how the singular fact to many occurs, of short guns excelling their longer competitors, and how frequently a particular maker obtains an immensity of credit for an excellent gun

only twenty-two inches, "beat my lord so and so's of thirty inches, and how, when I cut four inches of my double, she shot better than ever she did." All these occurrences are perfectly dependant on a knowledge of the generating of the explosive force, and may be reversed at any time by a person possessed of sufficient knowledge of these facts; for, alter the case, put in coarse grain into the short gun, and fine into the long, and the facts will be changed considerably, as will be easily seen. A degree of mystery has hitherto existed as to the cause of this discrepancy, but we trust this explanation will clear it up.

Our change of opinion, on the explosion of powder, has been produced by complete conviction; experiment alone has shown the error of stating only a certain quantity could be consumed; we fell too readily into the generally-received opinion, that this was the fact, for the proportion was considerably below the real quantity, as the experiments of punching the plates show; for twelve drachms can be burnt in a three feet barrel, therefore ten drachms may be consumed in one, two feet eight inches, with a given weight to lift. In addition to this, must be placed the fact of improvement, both in composition and granulation of the powder, which we have no hesitation in stating has been considerable, within only a very few years, all tending to the quickness of generating force. The granulatory system, if

acted upon, will give the sportsman or soldier a completely new power in gunnery, for it must be evident, if we have the means of projecting certain bodies with an extreme velocity, say 5000 feet per second, it becomes a simple calculation, the quantity of force and length of tube to give this to a certain weight. Take, for instance, an ounce ball in a barrel two feet six inches long. Extremely fine grain powder, from its rapidity of expansion, gives to the ball this velocity at fifteen inches from the breech, the remaining fifteen inches contain a column of air highly condensed, which will inevitably reduce this velocity back nearly fifty per cent., or 2500, and with that velocity the ball leaves the muzzle. Therefore, as we have already said, it must be evident you have here generated a high speed to be as quickly reduced, and it shows clearly, that if a different grain of powder would expand from breech to muzzle, increasing the velocity on a granulated scale, until it obtained the highest, or 5000 feet per second, as the ball left the muzzle you would save here clear fifty per cent. in force, with less recoil, less internal strain on the barrel, and with exactly the same weight of powder, therefore, shewing that you have just a definite quantity of force in a definite quantity of powder. The true science of gunnery is the knowledge how to best arrange the collateral parts, so that you may obtain the greatest result with the least means. We have also clearly

shown, that the resistance of the atmosphere is one, and the principal obstruction in the attainment of high velocities, its resistance being regulated entirely by the degree of speed with which it is wanted to be displaced; and thus it is true, as both Robins and Hutton have shown, that only a certain velocity can be obtained beneficially, though the degree is considerably greater then either conceived, as greater impetus, by far, has been obtained, and projected bodies have ranged much beyond their calculations, and that beneficially too. One draw-back on the theory of these gentlemen, is their calculating the velocities with iron projectiles, for the heavier the material the more powerful the momentum, and consequently the longer retention of the velocity, from not presenting the same space to the resisting medium, the air.

This singular and peculiar property of air, to resist when acted upon with sharp motion, points to curious and wonderful results. The hitherto thought impossibility, merges within the range of probability. We mean the power of flying in the air. If ever a velocity can be given to flappers, or propellers, greater than the velocity of sound, the air would form a body as firm and dense as to become the means of suspending many hundred pounds weight; therefore we say, it is much more than probable. We have machinery that can do this, and the arrangement would only require that the air should

be acted upon only in one position, and that a downward one in rising, and moderated in descending.

The power of locomotion too, may be got from it in the same way, if the principle of velocity is acted upon; by the by, we have frequently noticed the immense waste of power, by the waste steam in locomotive engines striking the air with a tremendous force, perpendicularly; were the funnels placed at an angle, the force of this steam would act as a propeller to a certain extent; the action of the propelling power in a skyrocket, is this alone, though with a greater velocity. We are however aware there may be considerable objections raised, such as dirt, smoke, &c.

The developement of the system of granulation must and does exercise considerable controul over the shooting of barrels of every description. We have already explained the curious (hitherto considered) phenomena of short and long barrels shooting so dissimilarly, and this illustration completely establishes the fact of the expulsive and repulsive forces being controlled by each other, as either preponderates, so is the result; the open-ended barrel projecting balls, and eventually bursting, is a beautiful and interesting elucidation, both of the force of gunpowder, and the stubborn nature of the atmospheric fluid. All these facts are valuable, inasmuch as they lay bare circumstances which have never

been satisfactorily accounted for, and enables the mind of lowest capacity to understand the cause and effect.

The superiority of one barrel in throwing shot stronger and more evenly distributed, it will be easily seen, arises from the absence, or existence of, internal friction when contrasted with the different degrees of expelling force, and the degree of resistance from the atmosphere; it also accounts clearly for the fact of guns shooting stronger on one day than on another, in fine and in coarse weather, for the weight; the resistance of the air is the only cause of the variation, for gunpowder cannot drive back a dense atmosphere as quickly as a lighter one. The cause of guns bursting, is to be placed to the account of both air and the generation of the explosive fluid so instantaneously; the solid front, air

no experiment that we could conceive capable of giving any elucidation, but has been tried effectually both with shot guns, and with rifles, and are clearly satisfied and convinced, that a grain containing at least four of the ordinary sized grains in one, is the best for ordinary sized guns, say 14 or 15 bore, and from 30 to 32 inches long, any thing shorter or smaller in the bore, will do best, with what is now called No. 2 grain, and believe us it will be a very small gun indeed to which we would apply, what is known as "Diamond grain," a *powder* in reality, approaching, too near what may be termed sifted dust; one additional defect appears to be its inability to stand abrasion, or carriage, as after a day or two in the flask it acquires a very dirty appearance. Our friend Mr. Edge, of Manchester, has long had a peculiar grain made for his tube guns, it is nearly the size of No. 10 shot, and what I have tried as No. 6. He and many who use his tube guns, speak very highly of it as shooting stronger and cleaner than any made: of both we have no doubt, and the latter alone ought to be a point of great importance to the sportsman. The question has been frequently asked us "how is it cleaner?" we answer, by being more evenly distributed over the interior of the barrel, continuing to burn longer, it is deposited all up the tube. The extreme fine grain is burnt within twelve inches of the breech, and is deposited in that dis-

tance, hence the "fouling" and "clogging" up of the barrel. All large guns should have a large grain used in them, and the advantage would be that the gun would be powerful in proportion to its dimensions, which is certainly not the case at present; in all duck or stanchion guns, the granulation admits of a vast increase in size. In the Appendix will be found a paper or two of experiments, written for one of the periodicals, as also some extracts from old works.

John Hall and Son, of the Faversham Mills, have made for us many samples, and of a quality to call for our utmost praise, and we feel bound to record our belief that there cannot be better material manufactured, the wish to please, is such as to ensure the patronage of all unbiassed sportsmen; ask, we advise you, for Hall's No. 4 grain, if you will try the extreme, at any event; No. 3 will be an improvement.

Next in the scale of quality is the manufacture of Messrs. Pigou and Wilks, it is a good, clean, distinctly grained powder, but giving, in every trial we subjected it to, results not so satisfactory as Hall's. Curtis and Harvey stand third on the scale, and if they abandon their extreme fine grains they will effect an improvement. We are perfectly aware that very few of the gunpowder makers agree with us in our views of granulation, and they argue from their own system of proof, which is generally

that of projecting a heavy weight by the aid of a small mortar; this with the displacement of air, (the great end to be accomplished) bears no analogy, the intents and purposes to be attained are as wide as possible, and we fear until a proof can be invented to define accurately the expansibility of the gases, we shall be unable clearly to convince those, whose views or benefit lying in opposite directions are slow to become converts.

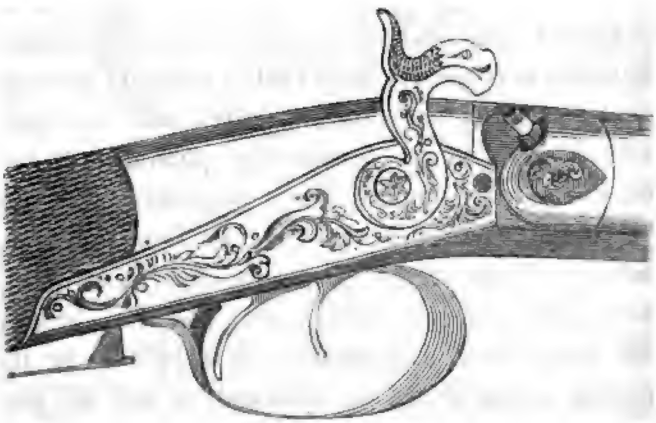
There are a variety of plans, alterations, and patents for improvement in guns, but all, less or more, partaking of the complex. Charles Jones's patent possesses, if we believe the prospectus, an immensity of improvements in projectile science, according to his own account only, for he says "It has cost me three years of unremitted application, to bring it to the state in which it now is, and which, I flatter myself I may say, without violating truth or propriety of expression, is, mechanically speaking, a state of perfection." To repeat all Mr. Jones says for his invention, would be trespassing upon the reader, therefore we shall dismiss the subject, by saying that the mechanical arrangements are certainly very nice, only a little too complicated; simplicity in a gun is as essential as any one other point, and though he gets nearly a centrical fire, which is certainly a desideratum, he must give way to an *invention* of Mr. Joseph Bentley, of Liverpool, who certainly obtains the most direct of any

yet introduced. The motion is given like Mr. Jones's, from a main spring on the trigger plate, which is also the lock-plate; a very simple parallel motion is applied to a pin, which travels backwards and forwards on a line with the centre of the tube of the barrel. The patent breech is a cavity like a closet, with a cover to open and shut, which cover is secured by the action of the pin, so that when the cock is down it will not open, and requires the lock to be half cocked. By opening the *door*, you perceive a nipple, screwed in on a perfect line with the tube, place on this the cap, *shut the door*, cock your gun, and she is fired by the steel pin striking the cap on the point of the nipple, perfectly centrical, and totally free from explosion in the face, danger of caps flying, &c. The cock is in the front part of the guard, and by pressing it and the guard between finger and thumb, the lock is cocked, &c.; the cock forms a tumbler also, similar to the arrangement of a saddle pistol; it is very ingenious certainly, but is borrowed from a French toy, of an invention for firing ball by a large cap containing fulminating powder, which together with the ball, is introduced at the breech. The inutility of it renders it not worthy of notice, as being fit for such purposes only as an air cane is available for. There is an extent of ingenuity displayed by Mr. Bentley, in a variety of ways, seldom to be met with; a visit to his shop, by those interested in the beauty of

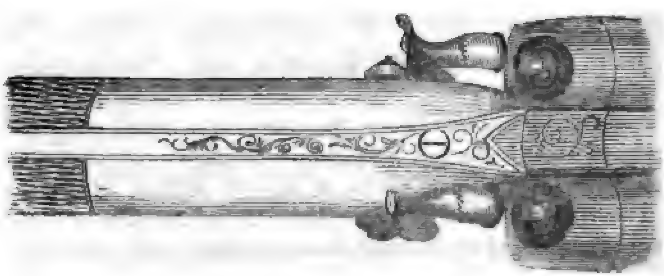
complex inventions, will be amply repaid for their trouble. He is the inventor of the revolving six barrelled pistol, which many London makers are advertising; he invented, ten years ago, a horizontal wheel, which contained seven charges, and could be fired in less than half a minute; and singularly, only a few years ago, a maker of some celebrity, sent a puff the round of the press, announcing his invention, upon this identically same principle and arrangement, full seven years after Mr. Bentley had thrown it aside, as impracticable for general purposes. We would advise a visit to Birmingham by some inventors, just to see what has been done, ere they commit themselves, both in purse and reputation.

Many ingenious emanations or productions of fertile brains, are to be met with in all parts of the kingdom, but the most essential point is generally entirely overlooked by inventors, and that is the generality of them involve a change of motion, or alteration from the long established system of using the cock, and there is a prejudice, begotten by custom, that it is difficult to alter, in even very young sportsmen; and it becomes of the greatest importance, that there be, above all other things, no extra manœuvres necessary in loading or priming, even the slightest is of consequence. Both Jones's and Bentley's inventions require additional movements, and are by many rejected on that account solely.

We have studied long and hard to overcome those objections, and have succeeded to our own, if not to the satisfaction of many sportsmen who have inspected it. The wood cut beneath, shows a side view, displaying the right lock, breeches, &c.



The cut below gives a representation of the top of the breeches, false breech, &c., and the form of the stock, the fixture of nipples, &c.



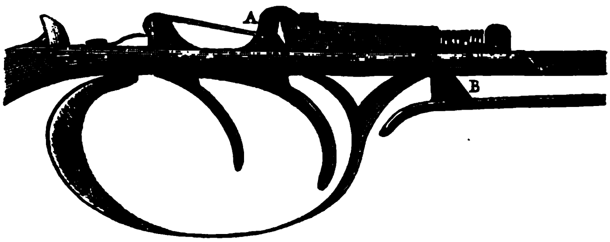
Here is a centrical fire, not so direct as Bentley's

but more so than Jones's, with nipples, locks, &c., outside, and liable to none of the objections the others possess. The only obstruction we found, was the very small and comparatively weak fore part the stock would have if the locks were jointed so close as they are represented, and, consequently, we adopted a fore part of iron, with a portion extending backwards nearly to the heel of the hut; the triggers are hung in this iron part, and the locks secured to it in the firmest way possible with two screws; the false breech has a projecting hut, and fits into a cavity between the two breeches, being just the reverse of the present arrangement of the huts of the breeches, fitting into the false breech. The mechanical composition, is simplicity to the greatest extent it can be obtained, as will be perceived.

The safety-guard which is adopted with it, is a plan we invented ten years ago* (and it is now eight years since we made this plan of gun first), and certainly it is the most perfect and simple of any, being a sliding bolt, with a projection covering the arms of the scears and triggers at once, it completely

* Since this was written, we have received a letter from Mr. Laing, of the Haymarket, enclosing a description of his safety-guard, which, strange to say, is of the very principle of the one here described. On inquiry, we found one of our men, who had just been employed by us, made the same guard, on the same principle, for Mr. John Boston, of Wakefield, eighteen years ago, so that neither of us have the priority of invention.

prevents the locks from being cocked or fired, without the lever is pressed.



A. is the hook of the bolt, securing scear arms and triggers.

B. is the lever which forces back the bolt by an incline travelling on a roller.

C. is the bolt and spiral spring to force it forward.

By gripping the handle of the gun, the bolt is drawn back, and the whole of the machinery is left at liberty. The moment the hand is eased, the bolt slides into the former position, securing the gun from the possibility of going off, without the will of the user. The principal improvement consists in the bolt securing the scears instead of the triggers, as all former plans do. We can firmly recommend the adoption of it, to those who think their safety worthy of such a slight additional cost, as its simplicity adds no additional complexity to the gun, and is a very slight encumbrance. When we consider the many serious accidents that yearly

take place, from individuals shooting themselves or others, from the want of such an arrangement, it behoves all sportsmen to adopt some such security, if not for their own, for the interest and safety of their companions.

We have re-printed the last six pages, to enable us to express our experience on the much sought after desideratum centrical fire. Jones is dead and his invention may be said to be dead also, save that we see them in the sale-shop windows we might conclude there had never been such a patent; another proof, were more required, that complication is incompatible with any successful improvement in gunnery. Bentley's may also be said to be defunct, none or very few are now made. The next thing to complication to be avoided, is any change in the routine the sportsman has been accustomed to; this gun is perfectly simple, but yet the trouble of priming being increased, no one will have it. Mr. Bentley having found this out by experience, has taken another patent for centrical fire, with all the manipulations as at present. We have effectually tried this principle of central fire, and have considerably wavered in our opinion of its great advantage; that it is quicker, we have not the slightest doubt, but that it is so vastly stronger we also doubt, or at any event it is not sufficiently demonstrated to allow of a clear and definite opinion. But it is quite clear that considerable danger attends it, as without the main-spring be very strong the

escape of exploded fluid by the vent, will drive up the cock to half bent, and when the hole in the nipple wears large, is very apt to drive it up with considerable force, as frequently to break off the tumbler neck, an accident of considerable danger, and the probability of danger ought to neutralize any little advantage that may in reality exist. It will be perceived that the two angles in the ante-chamber prevents this action in the ordinary breech. Several patents have been lately taken for self-capping guns. The best is Needham's; but as all this induces complications to do what the shooter can do much better himself, we can never recommend their use to any but those sportsmen who cannot carry their own gun in the field, but take it from their servant when the dog points. It will suit a parlour sportsman

Experiment is productive, to a reasoning mind, of curious elucidations of the principles of the laws of nature, and enables man to draw conclusions, adding, though it be but a mite, to the store of science, and productive of good to the whole human race. The following observations, though not bearing on the question, will not be out of place.

The peculiar laws of heat display themselves in many instances. We have found that, in common barrels, where the fibres of iron run lengthways, the heat is absorbed and diffused from end to end of the

barrel very rapidly, and its effects are dissipated in a comparatively short period ; but in a twisted barrel, where the fibres run in circles, or spirally, the heat is absorbed, and plays round the barrel, and is diffused in the longitudinal of the tube much slower than the former, but the particular part which has absorbed the heat retains it nearly twice the period, fully establishing the fact, that there is to be obtained a great benefit in the construction of vessels for the generation of steam, or, in fact, any other vessel where the absorption of heat is a desideratum. This can be obtained, merely by placing the fibrous system of the metal at right angles to the current of heat, for the fibres receive and convey the caloric to their utmost limits in a comparatively short time, and if this is in a line with that current, the benefit obtained is short in comparison to the reverse. We throw out this fact for the adoption of the engineering world, for in cases where fuel is expensive, the economy of heat must always be an object of the first consideration. We have advised a few boilers to be constructed with this end in view, and the result has justified us in recommending the subject to the attention of those whom it interests more pecuniarily than it does ourselves.

One plan of firing by percussion approaches near in principle to the flint lock, and which we believe, was first invented by Joe Manton, we mean the copper-tube gun, which is, in principle, a pistol firing into the bung-hole of a barrel. It is very

rapid, and the explosion has a tendency to check the escape of explosive matter from the vent to a certain extent, but not nearly sufficient to place it on an equality with the copper cap; and the liability of the powder in the vicinity of the vent to imbibe damp in a humid atmosphere, will always be an objection to it, which is probably insurmountable. The addition of cover and spring to secure the tube, too, is an additional complexity in cleaning, &c. But our friend, Mr. Edge, of Manchester, one of the number of talented provincial makers who practice science for its own sake, has an excellent simplified plan of a tube gun, which, to those who admire them, we would advise a trial. The tube is constructed by being attached to a copper cap, inserted into the side of the breech, is a projection like a nipple; the point of the tube is inserted into the cup of the vent, and the cap on the nipple at the same moment, which secures the tube in its place, without the aid of either cover or spring. It is the simplest tube-gun we have seen.

He has now succeeded in getting it perfectly waterproof by the aid of wax of his own discovery; the end is dipped into it hot, and sufficient is retained around the outside of the tube to make the gun waterproof when it is inserted into the countersunk touchhole.

We have frequently been applied to, to make some improvement in this method of ignition, such a favourite is the plan with pigeon shooters, that they

will use nothing else. At last we have started, and though not sufficiently perfect, yet we feel justified in announcing before the beginning of another "Red House" campaign, we will introduce to the world a tube gun more simple and perfect then any yet seen.

Mr. Blaine, in his Encyclopædia of Rural Sports, has the following: "The increase of metal in the detonator we think, with Colonel Hawker, to be an essential requisite, first, to resist the quicker, and consequently, more forcible expansive force applied by the ignition of the powder, through the agency of detonation, and tend to lessen the recoil so much more forcibly felt in most detonators. This increased weight of percussion Mr. Greener, however, objects to, and enquires, 'Whether some of the best flint guns met with, have not been very light?' To this we answer, that it was the principle on which the explosion of the flint gun was effected that enabled it to be made lighter, and yet to remain equally safe in using; but we also know, that where it was required to add to the rapidity and force of the ignition, it then became necessary to increase the substance of the barrel." Experience teaches the writer, and we dare say would Mr. Blaine, if he would take the trouble to experiment to the extent we have done, that there is no rapidity in the ignition further than the closing of that point of ignition by the cock, and no "force" further than the com-

parative instantaneous ignition of the gunpowder in the nipple creates, as this is quite sufficient to prevent the further penetration of the percussion flame; and the only increase, to quote his own words, " to resist the quicker, and, consequently, more expansive force, applied by the ignition of the powder through the agency of detonation," arises from an improvement (as it is termed) in the granulation of the powder, which alone creates the increased expansive force, as will be clearly understood by any one reading this work from the beginning, for the only difference between the flint and percussion systems is the stopping of the orifice of ignition in one, and allowing it to escape in the other, for the flame has to travel to *windward*, to use a nautical expression, in the flint; the other has its own accumulating power to force ignition through the body of the powder. This alone constitutes the difference. The necessity for an increase of metal at the breech of a barrel, does not arise from any peculiarity in the mode of communicating the fire, but in the increased inflammability of the powder alone. The immense increase of the smallness of grain has effected this more than the use of fulminating flame; the continuous cry for fine powder, to get better up the nipples, has produced an alteration which is placed wrongfully to the credit of the percussion. Again, he says, " Mr. Greener, however, would have us acquire this increase of power of

resistance, not by quantity of material, but by increased tenacity and elasticity in the metal the gun is formed of, and we agree that it would be a great improvement if it could be brought about. But what is our prospect of it? Is it not the general complaint that gun metal is not by any means what it was? We have shown that it is not; and, therefore, we do not think, as Mr. Greener asserts, that any recommendation of increased weight of metal to the percussion barrel beyond that of the flint gun "founded on ignorance;" but, on the contrary, that the very reason Mr. Greener gives to prove it, is that which we think affords evidence of its perfect rationality, *the explosive force created.*" The answer given above applies to this also, and, save on the score of lessening recoil, superior quality is preferable to quantity.

The shooting powers of gun barrels are dependant on two circumstances—goodness of metal, and a proper shape of exterior; for it cannot be too often repeated, *that a gun barrel is a spring* to all intents and purposes; and if you add metal, you add stubbornness, and destroy that expansibility, without the existence of which the barrel is, comparatively speaking, useless. Heavy, ponderous barrels do not propel a charge of shot with either that smartness or degree of closeness that a barrel more scientifically constructed does; you have less recoil certainly, but the addition of half an inch of more metal behind

the butt of the breech would do this more effectually, and save you carrying an additional weight. The gradual ignition of powder obviates the necessity of a great thickness of metal in the sides of the barrels; but if it is determined to persevere in the use of peculiarly fine grained powder, you would certainly be justified, nay, required, to have more and better metal than at present, for the electrical nature of the explosion will throw upon the tube that force which would be more judiciously employed in giving impetus to the charge of projectiles.

To quote further from "The Gun:"—"We have found that expansion will increase the shooting powers of a barrel, but then it must not be the expansion of an unelastic piece of metal, but whose elasticity rebounds with a force equal to that with which it expands; for whatever else you may obtain by creating friction, by boring the breech-end of the barrel wider, you obtain a greater expansion, as it no doubt has that tendency. We find it an invariable fact, that when barrels are very heavy, compared with their size of bore, (if a cylinder), they shoot weak. Also, when barrels are made of irons of different temperatures, where one is placed to prevent the expansion or springing nature of the other, they are never found to shoot well. As a proof of this fact, let any one take the best barrel he ever shot with, and encase it with lead very

tight; fire it at a dozen sheets of paper, and see if the effect be equal to what it was when the barrel was unencumbered. On the contrary, it will be found to have shot very weak, though close. Let him then examine the lead; and, if any moderate substance, he will find that the explosion has enlarged it considerably. This experiment we have tried repeatedly, and can vouch for its truth.

"The proof of barrels is another fact in corroboration of the truth of our assertion. What else can occasion the bulging, but the expansion, where the barrels are possessed of soft and hard portions, (which is the result of different tempers of different metals); one expands further than the other, and then, of course, the soft part receives no assistance from the hard, and it does not return to its original state.

"Put on a barrel, from the breech-end to the muzzle, a number of rings of lead; be sure you have them tight and not further apart than three or four inches; fire that barrel with a usual charge, and if it be a correct taper for shooting, it will have expanded the whole of the rings an equal distance.

"From the observations already made, the reader will perceive that the shooting of all barrels depends on a certain degree of friction. The degree of friction necessary, varies according to the nature and substance of the metal. Those metals that require

least shoot best. The object of the friction is to create a greater force, by detaining the charge longer in the barrel. If, then, there should not be an extra quantity of powder to consume, the friction would be a decided evil. This may be understood by rifle practice, in which we find that a short barrel of eighteen inches, with a certain charge, will throw a ball as straight, and quite as strong, or stronger, than a barrel of three feet, loaded with a similar charge. We account for this fact thus,—the barrel of eighteen inches will burn all the powder put into it; the long one can do no more. As soon as the ball has left the short barrel, it meets with no impediment but the air. By the time the ball in the longer one has travelled eighteen inches, the powder is all consumed; the volume of air in the remaining eighteen inches acts as a destroyer to the force given to it, and it naturally drops its ball short of the other. Increase the charge of powder to as much as the long one can burn, and then it will throw its shot to twice the distance of the other.

An addition of powder beyond the quantity the barrel can consume is disadvantageous—the reverse will be found equally so. Thus it is with fowling-pieces. The quantity of powder that a gun would burn in the shape of a cylinder, would be too little, when, by altering that shape, you increase the friction The quantity must, therefore, be increased, or this friction will diminish the force of the shot.

It is on this that the mistaken supposition is founded, that short barrels will shoot as far as long ones. It is true that with a small charge, or very fine powder, the short barrel will kill at the distance of thirty yards, as well as the long one; but put in the long one as much powder as it can consume, then try the two at twice the distance, and you will find out the mistake under which you have been labouring."

It is on the nature of the metal that the goodness of the shooting principally depends. That barrel which is possessed of the greatest degree of elasticity and tenacity, will throw her shot strongest and closest with the least artificial friction. It is on the knowledge of the qualities and temperatures of the various irons, and on practice in the art of shooting, that a man's ability in making guns shoot with precision must rest. All plans are merely methods by which an unscientific maker has most frequently succeeded. It would be no difficult task to produce a hundred barrels which will shoot nearly alike; yet every barrel shall be different in its bore.

"The length of friction depends entirely on the length of the barrel. Long barrels require more than short, though the latter require it in a greater degree. A mode of creating friction, much practised by those who are ignorant of the true method, is to bore the barrels as rough and as full of rings as possible. These rings are often taken for flaws; though that may be ascertained by noticing whether

or not they have the same inclination as the twist, and whether or not they are at the jointing of a spiral. If they be not, the chance is that they are ring-bored, as they are termed. This roughness, however, answers the same as friction by relief; but barrels thus roughened are very liable to lead, and become foul. While the well-bored barrel will fire forty shots as well as twenty, these cannot be fired more than twenty times with safety and effect."

Each of the barrels in the table below, if 3-16ths thick at the breech, is equal to the pressure stated. The resistance of a charge of shot of one ounce we find to be more than stated in "The Gun;" and the additional increase of explosive force obtained at the moment of ignition, requires the amount to be much greater in computation, therefore we may safely take a pressure of 1700 pounds to the inch of tube. The reader will perceive, on reference below, that with the tube filled with powder for an inch in length, which is a small charge, the explosive force will be equal to 40,000 pounds, or nearly 1700 pounds to the inch.

		PRESSURE OF CHARGE.	SURPLUS STRENGTH.
Laminated and other steel barrels are equal to a pressure of . . .	lbs. 6022	lbs. 1700	lbs. 4329
Wire twist . . .	5019½	1700	3319½
New stub twist mixture .	5555	1700	3855

		PRESSURE OF CHARGE.	SURPLUS STRENGTH
	lbs.	lbs.	lbs.
Old stub twist . .	4818	1700	3118
Charcoal iron . .	4526	1700	2826
Threepenny skelp iron .	3841	1700	2141
Damascus iron . .	3292	1700	1592
Fancy twisted steel . .	3134	1700	1434
Twopenny skelp iron	2840	1700	1140

If the charge be increased to one ounce and a half, the length it occupies, and the lateral pressure, by the jamming, will create an additional pressure in proportion, or near 2550 pounds, as under :—

		PRESSURE OF 1½ OZ. SHOT	SURPLUS STRENGTH
Laminated and other steel barrels are equal to a pressure of . .	lbs. 6022	lbs. 2550	lbs. 3472
Wire-twist barrel . .	5019½	2550	2469½
New stub-twist mixture .	5555	2550	3005
Old stub twist . .	4818	2550	2268
Charcoal iron . .	4526	2550	1976
Threepenny skelp iron .	3841	2550	1291
Damascus iron . .	3292	2550	742
Fancy twisted steel .	3134	2550	584
Twopenny skelp iron .	2840	2550	290

A charge of shot two ounces weight, will be greater in pressure than barrels of these dimensions

are equal to restrain, and, consequently, no barrels should be charged to this extent at any time, but inferior barrels, as a matter of certainty, are sure to give way if so loaded.

		PRESSURE OF 2 OZ.	SURPLUS
	lbs.	lbs.	lbs.
Laminated barrels, &c. .	6022	3400	2622
Wire-twist barrels . .	5019½	3400	1619½
New stub twist mixture .	5555	3400	2155
Old stub twist . .	4818	3400	1418
Charcoal iron . .	4526	3400	1126
Threepenny skelp iron .	3841	3400	441
Damascus iron . .	3292	3400	
Fancy steel barrels . .	3134	3400	
Twopenny skelp iron .	2840	3400	

The above tables show clearly the danger of persevering in using heavy charges of shot, for it must be borne in mind accidental circumstances will increase this pressure, and never can act so as to lessen it. A foul gun, or a variety of other circumstances, being sure to increase the danger.

Having fully explained the nature of gunpowder it remains to say something about the other portion, namely, the shot. That a barrel creating explosive force, until the charge is in the act of leaving the muzzle, will shoot better then another which does not do this, there cannot exist a doubt, for this is

the germ of the science. Also, that the column of air in barrels, where the explosive fluid is sooner expended, acts upon the wadding, and influences the lateral direction of the shot, there can also be no doubt; therefore, more attention is requisite to this point, than is generally given. We are quite certain that all well-constructed barrels, both as regards metal and exterior shape, shoot best, shoot so longest, and foul or lead less than barrels having the aid of friction; soft barrels require it, no doubt, but why make soft barrels; the others cost but little more, and the superiority admits of no question. The quantity of shot is a matter of the first consequence, and we think we have so clearly established the fact, that the less the weight, in proportion to the force, the greater the speed or velocity given to that weight, hence it follows that to be beneficial, a certain quantity is suited. To quote from "The Gun."

"All guns, according to their bore and length, will shoot a certain weight, and a certain size of shot best. A great deal of shot in a small bore lies too far up the barrel, and creates an unnecessary friction; and the shot, by the compression at the moment of explosion, becomes all shapes, a circumstance which materially affects its flight. If of too great a weight, the powder has not power to drive it with that speed and force required to be efficaceous because the weight is too great in proportion.

Those who reason from mathematical calculation, will object to this doctrine. Say they, the greater the weight the greater the effect. No doubt it is so, if thrown with a proportionate force; but that cannot be obtained with a small gun. We must adapt the weight of projectile force to the power we are in possession of; and from many experiments, we are inclined to think, that a fourteen gauge, two feet eight barrel, should never be loaded with above one ounce and a-half of shot, (No. 6 will suit best,) and the utmost powder she will burn. A fifteen gauge will not require more than 1¼ ounce; and no doubt No. 7 would be thrown by her quite as strong as No. 6 by the fourteen gauge gun, and do as much execution at forty yards with less recoil; and setting aside all other reasons, we should, on this account, prefer the fifteen gauge-gun, if both be of a length, finding we can do as much execution at the same distance with one as with the other. To render a fourteen gauge-barrel superior, we think Colonel Hawker is right in stating, that it should never be under thirty-four inches, which description of barrel we very much approve. He also says, 'You cannot have closeness and strength in shooting combined beyond a certain degree;' an observation, in the truth of which we fully concur; it being found that where there is a greater degree of either strength or closeness, the other requisite is always wanting. Neither would it be advisable, as the sportsman will

find a medium decidedly the best; a medium that will give the shots fairly spread over a space of thirty inches diameter, at forty yards; and so regularly, that a space, which would allow a bird to escape, shall not occur above twice out of five shots, and each shot to penetrate through thirty sheets of paper. It will be found, that a gun doing this regularly, is far superior to one throwing twice as close and not one-half through the paper, as the latter will require four or five pellets to kill a bird, when two of the other would be quite as efficacious, on account of penetrating twice as far."

In favour of small shot, Mr. Daniel's observations are so pertinent, we cannot do better than quote him, he says, "The velocity of a charge of No. 7 being equal (we will say nearly) to one of No. 3 at that distance, (35 yards), and since small shot fly thicker than large in proportion to its size; and as there are many parts about the body of a bird, wherein a pellet of No. 7 will effect its vitality equal to a pellet of No. 2, the chances by using the former are multiplied in the workman's favour; for it is the number and not the magnitude of the particles that kills on the spot. They who prefer large shot, and accustom themselves to fire at great distances, leave nearly as many languishing in the field as immediately die. Whereas, those that use small shot, and shoot fair, fill their bag with little spoil or waste beyond what they take with them from the

field." To an old gamekeeper of his (he tells us) he has often put the question, "why he was so partial to small shot," and his reply was, "sir, they go between the feathers like pins and needles; whilst the large shot you use, as often glance off as penetrate them." No doubt, here Mr. Daniel is as correct as may be. Mr. Blaine says, query? But he ought to be aware, as we suppose he is,—but allows himself to lose sight of principles — that small shot can be, and are propelled from the barrel with an equal velocity with the larger, and it is only in the length of range that the greater triumphs; but if we take thirty or thirty-five yards distance as an average, the latter will not "*lead*" in the race. Therefore, the advocates of small shot have unquestionably the better of the argument at this distance; at greater, we will not dispute it, though we have picked up No. 5 shot 350 yards from the spot fired from; larger, No. 3, rarely reaches 400 yards.

Hard shot is not so liable to be mis-shaped, nor does it lose its velocity by contact, as easily as soft.

Under the head mixed shot, Blaine observes, "We do not believe any law in projectiles can be brought forward to prove its impropriety. The mass of shot is propelled by the expansive power of the powder; it is ejected in a mass, and when it separates, each shot carries with it its own share of

ejective force, with very little interference with any other, it being evident that the projectile force acting on each shot is in the proportion of its area of dimensions," &c. Here is a great mistake. The law of projectiles is not wanted to prove its fallacy; the laws of motion will do that, if you take any number of equal or dissimilar sizes of shot, and placing it as a charge is placed in a gun barrel, occupying ¾ of an inch of tube, there is, of course, a wadding between powder and shot, this wadding is or ought to be, a piston; you communicate velocity to this piston by the explosion; it to the shot immediately above it, that to the layers above, and so on until the whole mass is in motion; the velocity behind the piston is increasing to a certain point, where it ceases, then it is that the layer farthest from the piston, having received its maximum from the layers below, it travels quicker than its assistants who having parted with their force, fall behind in proportion, and so does each layer, even until the last one which received it from the piston, having cummunicated so much to his friends before him, he is left without himself; for it is an undisputed law in motion that one body may convey to another, by contact, nearly its own velocity, but in so doing, is sure to come to rest immediately; strike one billiard ball against another, if the blow is centrical, the ball struck receives the motion, the other comes to rest, and so is it with shot; it is only the layers next

the muzzle which strikes the target, the remainder fall without travelling the same distance. We have fired three balls from a rifle, and having them marked we have found the uppermost projected farthest, and the others in proportion; try it.

Thus, it is quite clear that in all charges of mixed shot, the larger will extract the velocity from the smaller, and consequently become useless for the purpose intended, this is unquestionable.

" In speaking of the longest duck or swivel guns, We may instance Colonel Hawker's account of the performance of these fowling artillery. It appears evident that they do not give anything like the execution which might be expected from their immense size and capability. The reason of this is obvious. From the great space of the interior, in order to receive that equal pressure on the inch, which a common fowling-piece receives, they should be charged in proportion to the increased size; but then we need not add they would become ungovernable; and in addition to this objection, they could not be forged of mallable iron so as to be safe, on account of the impossibility of forging a barrel of that weight by hand hammers, and the little probability of hammers ever being invented to work by steam to do it sufficiently quick. The greater the weight of the barrel, its strength is gradually decreased, owing to the impossibility of sufficiently beating it throughout the whole body. It must be well known to any one versed in mechanics, that an

anchor-shank weighing some hundred-weights, is easier broken than iron one-twentieth part of the weight, which has had the advantage of being forged by hammers, where the blows were felt through the whole mass. This cannot be the case in forging large barrels, as the workmen cannot use hammers heavy enough, and consequently the barrel is turned out of hand, with the pores more open than a piece of cast iron. They have tried this with small guns for the artillery, and it has repeatedly failed, entirely from the want of sufficient power to compress the iron.* All guns therefore, of an unusual size, are not of strength in proportion to a small gun ; hence the reason they cannot with safety be charged up to the corresponding scale. Neither are they of the length they should be, if the bore is to be the criterion. It must be remembered that to be charged in proportion, the pressure on the inch should be as many times the pressure on the inch of the small gun, as the one is the number of times larger than the other. If we come exactly to the real state of the case, we doubt much, (when taking into consideration the difference of surface), that the pressure on the inch in the large gun is equal even to that on a small gun. The comparison might be carried up to the largest artillery, and we doubt whether it would come up to this scale, as we well know that the heaviest guns will not throw their projectile

* See Appendix.

as far in proportion as the small gun, because they cannot generate the force required to do it. The same principle is applicable to artillery as to fowling-pieces.

"From the above data, we would say, never make duck-guns above seven-eights in the bore, if you wish them to kill at a great distance, and not less than fifteen or sixteen pounds weight, and full four feet long, because then you can generate strength sufficient. Therefore, instead of the large staunchion-guns being one hundred pounds weight, they should, strictly speaking, be two hundred, and so on. In proof of this, we may just mention that, upon repeated experiments, we have ascertained, that a double staunchion-gun, with each barrel of the same bore, weight, and length, as a single gun, will kill further than the latter; simply owing to the advantage of the greater weight of the double gun. We have made observations, when trying moderate-sized and shoulder duck-guns on that fine level piece of sand before spoken of, and by tracing the grazing of the shots, we have been enabled to pick them up. The large shot from the duck-gun, mostly No. 2, we found scarcely 400 yards from the spot where she was fired; the small shot, five and six, from a fourteen bore, were repeatedly picked up at 350 yards; thus showing that the large gun had not much advantage, but yet making probable many assertions we hear made of killing at seventy, eighty, and

sometimes a hundred yards, with a common sized gun. By this it appears possible; for shot that will fly that distance, must kill, if it hit during its flight through the first quarter of such a range; but then, at a single bird, above fifty-five or sixty yards, it is always twenty to one against hitting the object at all; as the pellets begin to separate rapidly at that distance, though their force is still sufficient, and in large flocks is apt to do execution."

The invention of the patent wire cartridge is rather the production of a scientific mind, than the production of chance, though the invention of General Sharpnell contains the principle, and the perfection they have attained is but the extension of that principle; the means of projecting a number of bodies of a similarity in size, without subjecting them to an extreme jamming, by the lateral expansion, and thus allowing each to travel his allotted distance without any of his companions robbing him of his speed by impact. The great peculiarity of this cartridge is, that being less than the bore, and having no bottom wadding, the explosive fluid acts all around between the sides of the barrel and the net, by what may not inaptly be termed the windage, and they are thus expelled by a cushion-like force, which does not jam or compress the shot in the way it is liable to, by a wadding forcing it outwards. Here the net is of use to keep the whole in a mass; but you must not suppose the same

would be obtained by a charge of shot, without a wadding below. The net opens after leaving the muzzle of the gun, and the shot is left travelling behind; clearly proving that the main body of the cartridge has more velocity than the detachments. The introduction of the bone dust is intended, and answers the purpose of preventing the grains of shot being mis-shaped, by the compression; during their passage up the barrel they form a comparatively solid body, and keep the pellets from impact, and thus allowing it to go forth into the atmosphere beautifully round and uninjured; and, as such, more likely to travel farther and stronger. The latter arrangement possesses all the science, as the net can be dispensed with, for it aids the combination but slightly, and in no case more than a moderate quantity of good paper would do. J. D. Kedward, Esq., of Westhide, Hereford, has for some years made his own cartridges, observing the necessity of filling not only the interstices between the grains of shot with bone dust, but adding a little more to form, as it were, beds for each shot. And having the diameter of the cartridge some sizes less than the interior of the bore, they shoot equally well, compared with the wire cartridge. He uses nothing else, and shoots as well, and kills as oft, as any sportsman we know of. Any one, to whom the trouble is no consideration, will amply repay himself by the experiment.

"Berney's" spiral wire cartridges have come into great repute within the last two years, and by some sportsmen are very highly spoken of; the spiral wire must have a tendency to keep the shot better together than the gauze wire in Eley's, otherwise the packing of the shot is on precisely the same principle.

A few years ago, we made a very excellent cartridge, and which shot equally well with any of the wire ones. Simply constructing them by the aid of a soft substance, composed of hair and cotton intermixed, a thin wadding, of less diameter than the bore, as before described, placed between each layer of shot, until the requisite weight of charge is obtained; the paper of the cartridge is secured by paste or otherwise at the end intended to be next the powder, at the other is a wadding to fit the bore, similar to the arrangement in Eley's wire cartridges.

The science of this mechanical construction of projectiles is perfectly in keeping with all the established laws of motion, and more particularly good in thus avoiding the necessity of lateral pressure on the sides of the tube of the gun, and the upper end having the means of better resisting the column of air in their progress outwards; for there can be no question but this controls and induces the divergence of the shot in leaving the muzzle. One of the old arrangements, often laughed at, we mean the bell

muzzle in old guns, intimate to us, that our ancestors possessed some smattering of science. As the relief in the muzzle of a gun has a tendency, by allowing a gradual expansion, laterally to keep the charge of shot better together, for it is quite apparent, that any body, severely compressed for a certain distance, expands in proportion, when free of that restraint, and the consequence is, to fly off at a tangent, as the friction of a crooked barrel induces a ball to fly in a line contrary to the bend of the barrel.

The extreme relief we find in some old barrels, is certainly not required ; but still it clearly shows that the principle was understood and acted upon, and the very extreme has been produced by ignorance, as certainly as the suggestion was a proof of knowledge on the part of the suggestor; for many think, if a small dose is good for a patient, a large one must be equally so ; even like ourselves of the present day, we discovered that fine gunpowder was advantageous, and we have carried the principle so far, undoubtedly overstepping the line to which it was beneficial we should advance, thus clearly establishing the truth of the old adage, "One extreme begets another."

Therefore, in advocating the adoption of gun-barrels of the very essence of iron, we also say, let that part of the tube, whose duty is the generating of force, be perfectly cylindrical, and let there be a

gradual expansion of the bore for a few inches in approaching the muzzle, that the restraint of the lateral pressure may not be too rapidly loosened. But yet let that expansion be so graduated that there shall not be an extreme either way, a scarcely perceptible relief; but yet one that will influence and prevent the divergence of the projectiles to a considerable extent.

Blaine says—" A very long barrel is liable to have the force of its discharge lessened by the increase of counter pressure in the greater volume of external air in a long than in a short barrel." It ought to be internal air. The column of air in the barrel is unquestionably calculated to lessen the force of the discharge. But we have already shown that this is completely controlled by the system of granulation. Further—" Its force must also suffer by the loss which the elasticity of the propelling gas experiences in its lengthened transit through an extended range of barrel." He is here supposing an instantaneous generation of force, which cannot possibly happen; and if it did, would be comparatively useless. But he is evidently on the real scent, if he could work it out. Again—" In such cases, it is probable, that the shot which should leave the mouth of the piece at the instant when the propelling force has gained its maximum in a long barrel, are detained beyond that particular limit of capacity, we have pointed out as inherent in each barrel, and

which properties, and which quantities of charge, nothing but repeated and varied trials can teach the owner of the gun." An excellent illustration of the "theory" of the resistance of the column of air in long barrels, with very fine quickly-burnt powder; and could he have pointed out the cause, the explanation would have been perfect; as it must be quite apparent to the reader, it is not the length of barrel that is in fault, but a want of a continuous producing force in the powder, for when all the charge is exploded, the maximum has been obtained, and clearly proves that the charge was too small to keep up that maximum, or that the grain of the powder was too fine, and thus too quickly expended, and leaves no discrepancy between the fact of long barrels being preferable half a century ago, and short ones now; for it is in the improvement of gunpowder burning in half the time now it did then, and leaves the question of length of barrel precisely where it has ever been. You may have any length you like in moderation, if you suit the grain of powder to it. And we are quite satisfied to steer between extremes, either too small a charge of projectiles, or too wide a calibre, and too heavy a charge of the former—a size of bore that gives, under all circumstances, the greatest range with the least amount of explosive material, which neither requires that to be to foo fine a grain, nor too coarse, is a bore of fifteen, and two feet eight inches long. Under all the

above circumstances combined, this size will long hold a position in the front rank of sporting guns.

We shall quote a few more passages from Blaine. "Our ancestors, it is well known, seldom shot with a gun barrel of less length than from three and a half to four feet. But what they acquired by length they gave up in width of bore, contenting themselves with 5-8ths of an inch or seventeen gauge. Query, were not standing shots more in fashion than at present." It was not necessary that standing shots were more frequent; but does Mr. Blaine not see, that both length and bore were in truth perfectly fitted, under the circumstances, and come much nearer the line of perfection than we do now? for the length suited the powder, and the column of air in a small tube offers less lateral resistance, in proportion, than does a column of greater diameter.

Again—"We shall commence by stating what may be considered as a medium length of gun barrel. Colonel Hawker confines the extremes to two feet eight inches and three feet. Mr. Joseph Manton, of gun-making celebrity, on whose opinion the Colonel relies much, and with sufficient reason, for he was an experimentalist, and took little on trust, recommends two feet eight inches, and twenty-two gauge as a general sporting length and bore of gun barrel. A barrel of a wide bore, and but a limited length, it is evident, should carry only a light

charge." Wrong, Mr. Blaine; the reverse; or how get you an equal pressure of the expelling force? There is a greater quantity of square inches of surface, or space, in a barrel which is of but little increased diameter over that of another.

"As regards the extent of range, we think that a very great mistake is made by many sportsmen who advocate the use of small shot as equally effective with shot of a larger size. It is true that small shot moves with equal velocity through the barrel; but the distance they are thrown to, and the force they carry with them, are very different: once released from the muzzle of the barrel, they meet with resistant forces from the air in proportion to their surfaces in the aggregate; and thus the retarding force (which may be calculated from a comparison of the resistance with the quantity of matter to be moved) will be exactly in the reverse proportion of the diameter of the different sized shot employed. It is hence explained why a musket ball, of an ounce weight, fired with one-sixth of its weight of powder, will range nearly twice as far as a pellet weighing but one-eighth of an ounce, fired with the same proportions of powder. We hope we have proved, therefore, to the satisfaction of the sportsman, that the partiality which some profess for small shot, is founded in error, particularly when directed against any object beyond twenty, or twenty-five yards." Wrong again, Mr. Blaine; the musket

ball will not range double the distance of No. 5 pellet, with the same proportions of powder. A ball, an ounce weight, will, with one-third of its weight of powder, range nearly as far as a six pounder, with the same proportion of charge; the only reason being a more economical distribution of force effected in the smaller piece than in the larger, and thus the velocity is greater. Small shot are projected with a velocity equally great as the shot of larger dimensions, and will maintain that velocity up to forty yards, as we have ascertained; after this, the momentum of the larger tells; not because it is greater in speed, but maintains it longer; therefore the question is, ten pellets or five, at the generality of distances fired. Mr. Blaine thinks *forty yards* a fair average, for he says, "On the faith of our own observations, we venture to assert that from twenty-five to thirty yards is the average range at which birds are killed with certainty."

"The recoil of a gun is inseparable from a discharge of its contents, on the broad principle that action begets re-action. It is therefore, only when the "Kick," as it is called, becomes painful, that it is essential to avoid or lessen it. Irregularity in the bore of the barrel is a very common source of violent recoil; *contracted breeches* also, but more than all, the contraction of the barrel at its centre, occasions recoil, and that of the most dangerous

kind. The expanding flame, during its ignition, presses violently to make its way through the contracted to the wider part, also destroying the expelling force. " Now, action and re-action being equal, it follows, that the weight of the piece being the same, the recoil will be in proportion to the quantity of the powder, and the weight of the ball, or shot, and that with the same charge the recoil will be in proportion to the weight of the piece, or the lighter the piece the greater the recoil."—*Essay on Shooting.*

Here is a true exposition of recoil, though not of contractions in the breech, for there the action would not be directly back, but an inclination towards the muzzle, for the re-action would not have time to tell on the breech, before the charge was out of the muzzle; an extremely spiralled rifle barrel destroys the explosive force of gunpowder, but the effects are not felt in the recoil, being most all expended laterally. Blaine says, " Could we entirely obviate all recoil from a gun," you might do so by weight, " we should not only remove an unpleasant shock to our persons, but there is reason to believe we should much assist the range and force of the shot likewise, although there is an opinion prevalent, that the degree of the recoil is in the proportion of the projectile force. Of this, however, some doubts are entertained, which are warranted by the following fact:—' Mortars with iron beds immoveably

fixed in the earth, throw their shot to greater distances than guns can do, which are affixed to carriages, and which, therefore, can recoil. This has been incontestibly proved both in large and small artillery. Having suspended a gun barrel, charged with a determinate quantity of shot, from the ceiling by two cords, so as to allow of its recoil, fire it point blank at a target, and mark the result accurately. Now, fix the same barrel to a block, and charge it exactly with a similar charge, then having moved the target fifteen feet (query, fifteen yards) further, fire the barrel, when it is probable that the last shot, though at this increased distance, will exceed the former, both in range and force.' These and such like experiments are laughed at by the giddy and inconsiderate, but it is by these illustrations that the most important facts are brought to light. Projectile force is therefore to be increased by resistance, and the knowledge of this fact offers us a practical hint, that when we stand immoveable to our shot, not only by holding the gun tightly to our shoulder, but by also *leaning somewhat forward* in our shooting attitude, we considerably increase the resistance, and, consequently, we not only lessen the shock of the recoil to ourselves, but we aid the force of the shot and extend its range. That such is the case, may be further exemplified by the following :—Throw a hand-ball against any moveable body, and it will displace that body ; but the ball will drop to the

ground perpendicularly, however hard the body, against which it is thrown, may be. Fix the same body securely, and then the rebound of the ball will be nearly equal to the force with which it was thrown." The whole of these experiments and illustrations are from "The Gun," and are not quoted; not that Mr. Blaine is in the habit of doing so; nor would we have mentioned it, but a considerable improvement has taken place in government arrangement from the publication of this very principle of resisting or lessening recoil, and if we allowed this to pass, it would amount to resigning what little credit may attach to such a considerable improvement in the range of projectiles, amounting to nearly one mile and a half.

"Bad powder increases recoil by delaying the liberation of the shot," or rather by the length of the period it exerts its pressure on the breech. Mr. Blaine has many remarks on the causes of bursting, but any person who has clearly read and digested the contents of these pages, will be fully aware that a want of strength, or the condensation of the column of air, are the principal causes. Many have asked us, what causes report? The driving back of one particle of air upon another. The millions driven back in an explosion, add by their friction on each other, their quota of sound; the re-rush into the vacuum is simultaneous;—the whole combined creates the one grand effect. The pigeon's

wing strikes not the air without sound; one bira accomplishes speed with a less wing than another, but he combines speed of blow; for the velocity finds, if great, a resistance greater in proportion.

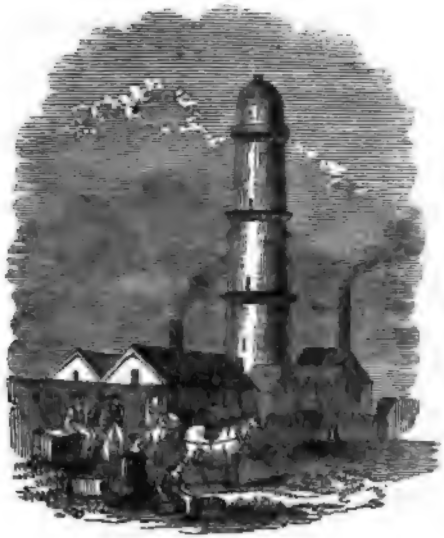
The science displayed by most of the continental nations in the improvement of gunnery, is applied principally to the perfection of their military weapons, and will be fully treated upon under that head. Shooting is no where carried to such an extent as in our country, nor any where so well understood and carried to such perfection. Foreigners are very scarce who can knock down their "right and left" in good style, they must have something easier, sitting, or at most, running seems to be their favourite shots. Their method of loading is the same as that of the last century, "plenty of lead," but little powder. Like our gunpowder, they highly estimate our gunnery, and give high prices. You will see lots of English guns exposed in Paris, at high prices too, but on examination, they turn out to be imitations of Mantons, Eggs, Purdeys, and other fictitious names, and generally third rate "*Brummagem*" ware.

In the course of last summer an "Electric Gun," termed "Siva," or the destroyer, was exhibited, and from the system of puffing adopted, was thought by some people to be a great card. The announcement that many thousand balls per hour could be projected and this continued to an indefinite extent, was cer-

tainly calculated to take effect, upon "*absorbing*" intellects, more especially when assumed by the ex. hibitor it would range a ball a mile, and do with ease the work of a whole battalion of infantry. Having, amid the many curious, visited it, we were certainly struck with the reflection what simple "toys" tickle great minds at times. The principle approaches as near as possible to that of "Perkin's" steam gun," only instead of the generation of steam, water is decomposed by a powerful galvanic battery, giving out in certain proportions the explosive gases under we should suppose a certain pressure; two orifices admit these into a vessel or space immediately in the *rear* of the directing tube or gun barrel, into which the ball is already admitted. A spark of electricity ignites the gas, and hence the explosion, which can be carried on so long or so quick as the decomposition of the water can be effected, which, it is a matter of certainty can only be to a limited extent, not sufficient certainly to enable the exhibitor to claim unlimited power. This reminds us of a circumstance which occurred on the introduction of the steam gun to the scientific world; amongst the many noble visitors tickled with the fancy was an illustrious Duke with a long retinue of "military savans." The gun was made to discharge its complement of balls and the proprietor very judiciously requested his visitors to descend into the "lower regions" to inspect the steam generator: this done,

the noble gentleman modestly enquired "but Mr. Perkins can you go on continuously?" Oh yes, your Grace, fire away, and sure enough another round of sixty shots was fired, and the party left highly pleased and astonished at the wonderful discovery. The fact was, a fresh supply of steam was being generated during the period the party were below. So it is with all such plans, to say you have possession of a power "ad infinitum," is too wide a claim: suppose we examine the "rationale" of the principle. To be equal in effect to a charge of 4 drms. of powder, an equal volume of gases must be exploded. Now if we refer back to a quotation from Hutton, page 225, it will be apparent that the permanent gases is equal to 250 times the pressure of the atmosphere or 250 times the bulk of gunpowder. We will suppose 4 drms. of powder to occupy one cubic inch of space, it follows that Mr. Bedingfield must explode 250 times that bulk of gas to enable him to obtain the same power that is obtained from 4 drms. of powder. Thus to fire 30,000 rounds would take 7,500,000 cubic inches of gas. How can this be generated? what sort of a Galvanic apparatus would be required? and to talk of carrying the principle up to the largest artillery, why this beats the "flying machine hollow." We have seen experiments made with those gases, have a friend who lost an eye and blew down a house side, in fact, we can speak feelingly, and have no hesitation in

pronouncing the whole a most ingenious toy, nothing else. It is adduced, look at "the way the target is splintered," but this is also only an apparent effect, every one knows a ball with a slight velocity splinters most; it is a common practice in naval warfare, when at close quarters to reduce the charges of powder. Half to three fourths of a drachm of powder would produce greater effects than any we saw produced, while again no machinery was ever yet perfected, no joints ever made that would long endure in all perfection the repeated explosions of anything in its nature resembling gunpowder, therefore we feel satisfied the "Siva" will never be a destroying power but in name. A machine to work gunpowder in the same way might be as easily constructed, but then who would work it, but it could be worked as safe as this only; but "what's in a name" must tell.



CHAPTER VIII.

ON SHOT, CAPS, AND WADDING.

THE method of making shot, originally, was by the most simple process. Having tempered the lead by a mixture of about 1-80th part of arsenic, the melted body was allowed to run through the holes in a cullender of iron into a body of water placed half-an-inch below. The vicinity of the water was required, to prevent the shot from being made flat-sided or oval: by falling on the water, the short drop prevented this.

A very laughable origin, the discovery of the patent shot had truly. An honest quaker, in Bristol, of the name of Isaac Watt, a brass founder, had long and fruitlessly endeavoured to make shot of a decent description. Disappointment always attended his efforts. Going one night weary and vexed to bed, and having but just fallen asleep, he was aroused by his better half calling "Isaac, Isaac, I say." "Well, what dost thou want with Isaac?" "Oh dear, Isaac, I have had such a dream!" "Hold thy tongue, and go to sleep, woman. Thou art always dreaming. I can't get sleep for thee and thy dreams." However, the good old woman, thus admonished, again resigned herself to the arms of Morpheus. But presently she assailed poor Isaac the second time with—"I have dreamt the same dream over again." "And what hast thee dreamt? —thee and thy dreams." "I dreamt that thou stood at the top of the stairs, with a pan full of that lead thee wast melting yesterday, and I held a washing-tub at the bottom, and thou didst make such pretty shot." "Ah! indeed," cried Isaac; "then get up and do as thee has dreamt." And, in truth, beautiful shot was soon produced. A few bags were got ready, and honest Isaac set off to London, got a sample shown to the Prince Regent, and in a very few days after, a patent had been obtained, a sale was effected to Messrs. Maltby, Walker, and Co., for ten thousand pounds, by whom the shot was

afterwards manufactured. The only instance we ever heard of such a sum being realised by a dream.

There was, for some years previously, very good shot made by a lead-miner, in Weardale, upon the same arrangement, and report says it was necessary to *palm* the operator to keep the patent perfect, for an addition of five shillings per cwt. was charged during the entire continuance of the monopoly.

The manufacture is very simple: the lead is first tempered by the aid of arsenic in the proportions required by the slag (a technical term) for the kind used, some lead taking more and some less. The melted body is then poured into a pan placed over the mouth of the pit, or tower, (as may be in use): Messrs. Walkers, Parkers, and Co. have towers in their various factories where they make shot—the cut at the head of this chapter represents the one in Newcastle. Messrs. Locke, Blackett, and Co. cast down the shaft of a pit, and by this means obtain a greater fall. The fluid takes a globular shape, and the concentric motion round the axis keeps it so until the passage through the air has extracted the heat before it reaches the body of water placed to receive it. Thus the only difficulty being in casting very large sizes, as if the distance they fall be not sufficiently great, the blow on the water in a semi-fluid state misshapes them. About three different sizes come out by one pan, which are separated by the aid of riddles; tabled, as they term

the process of placing a quantity on a sligt incline, and refusing those that do not run off; and then polishing the whole in a machine termed a drum, with a mixture of black lead, to give to it that beautiful polish which captivates the eye, but injures the shooting of the gun by adhering to the interior of the tube. All shot should be used unpolished, and the addition of hardness is unquestionably another advantage. Slag-lead is lighter than other lead, but it is much harder, and thus fitted for shot. We regret the disuse of the shot with quicksilver, as it is unquestionably much superior though more costly. A considerable improvement is yet to be introduced in the manipulation of shot-making; and we shall commence a round of experiments with that intent at the earliest opportunity; though no encouragement is to be expected from the monopolists, as the parties who made immense fortunes by the good woman's dream are so illiberally inclined as to refuse any inspection of their process, simple as it is—while our thanks are certainly due to Messrs. Locke, Blackett, and Co. for the handsome and gentlemanly way the leave was tendered. We seek the interest of the public more than private emolument, and they alone are benefitted. Some years ago, we succeeded in making a handsome specimen of shot with cast iron and one-hundredth part of zinc. The two are amalgamated in a liquid state, in a covered crucible, and cast by

pouring through a wire riddle. We are certain an experiment on a larger scale would succeed perfectly, though the specific gravity is of course less than shot of lead, though not such a difference as is usually imagined, for the slag and arsenic being lighter, reduce the specific gravity of shot below that of lead. Iron shot could neither be misshapen by compression nor lose its force by contact, and, at moderate distances, would be sufficiently efficacious.

Copper caps are now so general and so well known, that we shall occupy but a short time in discussing the question. It seems a paradox to us what induced the first manufacturers to use copper, as it is liable to many objections. It may have been noticed by many sportsmen, that after a few hours exposure to a humid atmosphere, caps frequently miss, leaving a white paste in and on the nipple. This is caused by a galvanic action taking place between the cap, the circle of copper, and the *iron* of the nipple, which partially reconverts the fulminating mercury back to its original state, and thus renders it inexplosive. The dêposit always instantly attracts the moisture, so that it is impossible to put the cap on the nipple without this action being induced: The remedy for this is in making caps entirely of iron, which gives you the means of avoiding this, and also to obtain a quicker and more perfect percussion; as the softer the body is in which the priming is contained, the slower must be the

communication of the blow, and the least effectual; while by using iron, you use a stronger body, not so apt to fly, and with the absence of the destructive principle alluded too. We have used some hundreds, and therefore speak from practice and theory combined. The iron is easily protected from rust or oxydisation, by the application of a japan varnish, which gives them, at the same time, an improved appearance. The cost too is, at the present day, a matter of consequence; and when we consider that copper costs £120 a ton, brass £70, and sheet iron of first quality only £20 a ton, the difference will be considerable. We have made them of tinned iron, an improvement on the copper. Cheapness being always the end most in view, both by the manufacturer and the purchaser, it is no wonder that alterations often occur without improvement being a part of the change. We say copper caps; we will have nothing but copper caps, say some sportsmen, and yet singular there is very few made or in use, at the present day, nearly all are "brass," coloured to accurately resemble copper. Therefore practice has effected a change, by doing it by stealth, which years would not have done if you had introduced them into the sporting world as brass. They are objectionable in several ways; first, to enable the brass to punch properly, it is necessary to anneal them to a great extent, and brass being at all times a spungy metal, their open

nature is calculated to lessen the blow of the cock considerably, and they open much and fasten themselves in the bell of the cock, an annoying matter sometimes during a hard day's shooting.

The mixture of fulminating mercury composition is—

Fulminating mercury,	3	grains or ounces.
Chlorate of potash	5	—
Sulphur . .	1	—
Powdered glass .	1	—

The above is one of the best compounds in use.

Chlorate of potash .	6	grains or ounces.
Sulphur . .	3	—
Glass, powdered .	1	—
Charcoal, ditto .	½	—

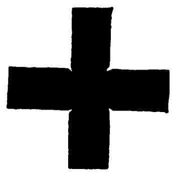
Is the best mixture where the corrosive principle is not heeded.

Excellent caps are now made in many parts of the kingdom. But like the manufacture of gunnery cheapness and great profits alone have rendered a very great quantity so inferior, and thus not to be trusted, that it is always good policy to go to the best market. F. Joyce having reduced his prices, gives him the first claim on the sportsman, as he unquestionably turns out a good article. We would advise him to consult the interest of the sporting world, by making the anti-galvanic caps, they would

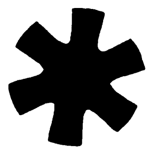
add more laurels to his head, and profit to his lockers.

In the present age of competition it is difficult to name the best manufacturers of copper caps, but if a spirit of improvement, a wish to perfect this adjunct to the sportsman's pleasure, a desire to furnish an article of the best description at the most moderate remunerating profit, be a recommendation, then we can strictly recommend the house of S. Walker and Co., 12, Legge street, Birmingham. We know a very large amount of capital has lately been sunk in machinery, to enable them to produce the greatest quantity at the shortest notice, and the very extensive orders they are favoured with bespeaks volumes. The greatest improvement the copper cap has ever experienced, is now about to be introduced to the sporting world by S. Walker and Co., as above, having just been registered according to act of parliament. It must be evident to all practical sportsmen, that whatever will tend to lessen the chance of a miss-fire must be an advantage, and this can only be effected by forcing as great a quantity of the explosive fluid of the copper cap down the orifice of the nipple as possible. It must have been quite apparent to most observing shooters that in ordinary percussion caps as much if not more of the explosion escapes or takes place outside of the nipple as is driven down. In fact a very small quantity is made available, and thus an unnecessary waste

is incurred, which, if it could be made available and driven down the nipple, must increase the certainty of firing. To effect this, the blanks from which the caps are punched is now constructed of a different shape as the woodcuts will show.



OLD BLANK.



NEW BLANK.

The greater quantity of metal left in the centre of the improved blank gives a solid cap for at least one half, and the explosive compound is thus contained within a sort of solid cylinder, confining the exploded gases by this solid cap and preventing them flying off laterally and often breaking the nose of the cocks in addition to the quantity of matter dispersing itself in all directions, to the evident danger of the sportsman's eyes; the tube being solid near the top prevents it opening when forced upon the nipple, and it is thus perfectly waterproof. One other great advantage is that they are not expanded near so much as the old plan of cap by the explosion, and thus never fastens itself in the head of the cock, or the possibility of any portion of the cap flying to the annoyance of the shooter; in fact the advantages attending them are numerous, and we feel confident they will supersede entirely the old cap as the improvement is so extremely simple and efficacious.

It is not my intention to trouble the reader with a long lecture on wadding, for experience has so convinced every one of the utility of using the felt wadding between powder and shot, that we need not say much on this point. The necessity, the absolute necessity of preventing the explosive fluid from intermixing with the particles of shot, is quite apparent, and has been insisted on before. Felt is possessed of great merit, but it is generally used too thick, and more fit for duck guns than fowling-pieces. Wadding should be soft though firm, and capable of lifting the charge of shot, and not separating in the act of doing this, and at the same time separating from the projectiles at the instant of leaving the muzzle, that it may become no incumbrance. A very hard wadding misshapes the shot, and at the same time gives it a tendency to fly off at an angle, by that very hardness. Joyce's are decidedly as good as any in use, when all points are considered, and as such worthy of patronage. A considerable decrease in thickness should exist in the wadding, for the top of the shot, as a great weight in this, must influence the direction of the shot laterally.

Richard Jones of Bedfordbury has introduced some excellent samples of felt wadding into the sporting world during the last few years. You can have it of any thickness or consistency, concave or not, certainly concave wadding is a great improvement if used properly; its intention is to enable you to dis-

pense with a less charge of shot, to use a full charge and a thick wadding is to increase the friction unnecessarily, but decrease the charge one fourth, and you will get the same result with the concave wadding that you get with the larger charge of shot and thin wadding, and with a sensible decrease of recoil. Wadding should be sufficiently tenacious in endurance to come out of the gun perfect; if it separates, or the explosive fluid blows through it, it is useless; this can easily be ascertained by examining a wadding after firing.

A great improvement was effected in the superior state of safety to the shooter, by the invention of the patent powder flask. We have frequently had occasion to notice of late years that there was a considerable falling off in workmanship and care with which these valuable adjuncts to a sportsman were got up; as a dealer in these, we have frequently had to complain. The manufacture of the best articles being confined almost entirely to one house, it suggested itself to us as a strange anomaly and we could account for it in no other way than supposing the want of competition caused the parties to become careless, and as wealth accumulates it frequently lessens the energy hitherto apparent in an extended degree. However, this want, we are happy to say, has been remedied in the commencement for themselves of G. and J. W. Hawksley, of Sheffield, late in the employ of the

Messrs. Sykes and Son. Their flasks are not only safe and vastly improved in workmanship, but the mechanism is of a superior order to anything that has been seen previously; their shot pouches, small flasks, &c. are also of the first order, so much so as to justify us in saying they make by a long way the best articles of the present day.

As we have frequently foretold, a universal cartridge has since the termination of Eley's patent been introduced into the sporting world. The principle is simply a cartridge of the form of Eley's, but without the wire gauze, (which was never of any use.) The interstices of the shot are filled up with bone dust or any other material, light and of sufficient substance to prevent the shots from coming in contact with each other. They shoot as well and more regular than the others; and as any party can make them, we have no doubt they will be shortly in general use, and a cartridge pouch will supercede the shot pouch, and in fact the use of loose shot altogether, as competition will soon reduce them to a figure within every sportsman's reach.

CHAPTER IX.

WHALE SHOOTING.

GUNS for throwing the harpoon were invented as early as the year 1731, during the flourishing period when the whale fishery was expected to be the means of enriching the half of Europe. The Society of Arts encouraged the improvement and use, by offering premiums to the maker, and to the harpooner for using them: a sum exceeding £350 was given for this end during a few years. Scoresby, in his Account of the Arctic Regions, says, "The harpoon-gun was invented in the year 1731, and used, it

Drawn by J.W. Carmichael. Engraved by T.E. Nicholson.

WHALE SHOOTING.

seems, by some individuals with success. Being however, difficult and somewhat dangerous in its application, it was laid aside for many years. In 1771 or 1772, a new one was produced to the Society of Arts, which differed so materially from the instrument before in use, that it was received as an original invention. This society took a great interest in promoting its introduction; and with some difficulty and great expense effected it. Between 1772 and 1792, the society gave, in premiums to whalefishers and to artizans for improvements in the gun and harpoon, the sum of £350 or £400. In one year alone (1791,) they paid 36 guineas as premiums to twelve persons who had been successful in the use of the harpoon-gun. Since the year 1792 they have generally been in the habit of offering a premium of ten guineas to the harpooner who should shoot the greatest number of whales, not being less than three. This premium, however, though it has been frequently offered, has been seldom claimed. The harpoon gun has been highly improved, and rendered capable of throwing a harpoon near forty yards with effect, yet on account of the difficulty and address requisite in the management of it, and the loss of fish which, in unskilful hands, it has been the means of occasioning, together with some accidents which have resulted from its use, it has not been so generally adopted as might have been expected."

"In its present improved form, as made by Mr. Wallis, gun-smith, Hull,* the harpoon gun consists of a kind of swivel, having a barrel of wrought iron, twenty-four to twenty-six inches long, of three inches exterior diameter, and one and seven-eighths inches bore. It is furnished with two locks, which act simultaneously for the purpose of diminishing the liability of the gun missing fire. The shank of the harpoon is double, terminating in a cylindrical knob fitting the bore of the gun; between the two parts of the shank is a wire ring to which the line is attached. Now, when the harpoon is introduced into the barrel of the gun, the ring with the attached line remains on the outside, near the mouth of the harpoon; but the instant that it is fired, the ring flies back against the cylindrical knob." Such was the harpoon-gun of 1820, and such it continued until the year 1836, when a succession of unsuccessful seasons induced Captain Harrison, of the Lady Jane, of Newcastle to get a new one, and cobble up one of the manufacture of 1819. The succeeding year he killed six fish with these two, at that time very inferior guns. We were then applied to by Captains Warham and Taylor, of the Lord Gambier, and Granville Bay, whalers also of Newcastle, to give the subject some attention. We did so, by lengthening the barrel, adding a little more weight, and reducing the bore to 1½ inch. By a judicious

* Since dead.

improvement of firing the gun directly behind the bore of the barrel, the addition of a conical form to the breech, and using percussion, we never have yet had a miss-fire, during one hundred shots. The construction of the lock is very simple, being upon the principle of a saddle pistol lock; the caps, the nipples and lock, are completely and effectually covered, and protected from damp, or spray from the sea. It is also securely bolted until the moment it is wanted; when, by the removal of a pin, the trigger string is pulled, firing the gun, and throwing the harpoon with considerable accuracy, to any distance under eighty-four yards, being the greatest range, by more than double, ever obtained with this description of gun. The charge is very small to project 40 lbs weight, for the harpoon itself is 10½ lbs., and an increasing weight of three-inch line from the gun to the extreme range, in all weighing full 40 lbs. This immense improvement is the result of calculations, deduced from the nature of gunpowder. The charge is short of an ounce of powder, but it is, or ought to be, good powder, of the largest grain; fine powder will not do it, but on the contrary, would jump up the end of the harpoon, or bend it, so as to be of no further use until repaired. In this, and the certainty of firing, consists the improvement, for the gradual ignition puts the harpoon in motion, it is not kicked out as for-

merly, but sent more graduated and evenly on its deadly errand.

In consequence of the improvement, the ships from Newcastle, obtained a full complement of six each, or one for each boat. The resulting fishing has been of that nature as to deem it more than probable the fishing will cease altogether in a few years. Though the use of the guns has been so successful as to kill, on the aggregate, fourteen out of sixteen fish, and these probably would not have been got at all without the guns, as it is invariably the practise to use the hand harpoon where hand harpoons can be used, so that if they fail, the gun is immediately in play. Fish have been shot at fifty yards, and have been got when swimming at the rate of eight miles an hour. Their use in killing the smaller whales, the Bottle Nose, and the Narwhal, which cannot be approached nearer than twenty yards, or twice the distance the hand can throw, renders them valuable acquisitions. A whale was killed by the mate of the Lord Gambier, in Baffin's Bay, in 1839, which rose directly with his head in front of the bow of the boat. The gun projected the harpoon into the crown of the head, burying it two feet deep, the point of the harpoon was bent as far back as where the metal becomes half an inch thick. Scoresby says, "the head of the whale is avoided, because it cannot be penetrated with the harpoon;" yet this fish was eventually

killed, and we have now the harpoon in our possession, a real curiosity. We have no doubt but the effect of the blow saved the lives of the crew, as the whale must have inevitably upset the boat: we shall quote the means used to approach the animal: "Whenever a whale lies on the surface of the water unconscious of the approach of its enemies, the hardy fisher rows directly upon it, and an instant before the boat touches it, buries the harpoon in its back; but if, while the boat is yet at a little distance, the whale should indicate his intention of diving, by lifting his head above its common level, and then plunging it under water, and raising his body, until it appears like the segment of a sphere—the harpoon is thrown from the hand, or fired from a gun. The former of which, when skilfully practised, is efficient at the distance of eight or ten yards and the latter at the distance of fifty yards or upwards. The wounded whale, in the surprise and agony of the moment, makes a convulsive effort to escape. Then is the moment of danger. The boat is subjected to the most violent blows from its head or fins, but particularly from its ponderous tail, which sometimes sweeps the air with such tremendous fury that men and boat are exposed to one common destruction."

Safety is thus consulted in the use of the gun, as well as great assistance in shortening the period during which the whale is capable of taking out

line. For in frequent instances the harpoon has gone into the entrails, and some small whales have been killed on the instant. During the period the fish comes up to blow, after first being struck, it is highly dangerous to approach within reach of his tail. But the gun will wound and facilitate his death. Lances are also thrown by them. In truth, it is but another proof of the theory we have formed of gunnery and the explosive power that yields the means. A vast improvement, an endless description of velocities, and modification of them, are to be obtained by the extensive field for experiment, but yet little understood.

Experience has proved the value of this invention. Every ship that goes to the fishing has now a full complement of six; nine-tenths of the fish got within the last few years have been shot. From a calculation we made after the conclusion of last season, it was very satisfactory and profitable to the owners of the ships if not to ourselves. We have every reason to know the amount of money realised by our guns amounted to little short of £100,000, and this with our manufacture alone, for we, like most inventors, have competitors, who manufacture upon our model and at less than our price. So soon as their supe riority was established, some houses in Scotland obtained guns from us and commenced manufacturing an article of a very inferior description, but low in price, and as Scotchmen are proverbially a saving

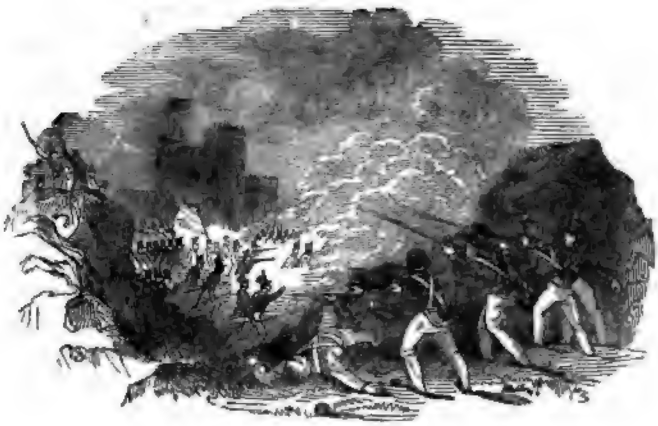
race, a great quantity have got into use, they are made of a very common iron, and not being within the jurisdiction of the proof houses undergo no test whatever. The consequence has been the bursting of several, and the loss of two valuable lives, and how many more as they become injured by use we dare not guess,—one other proof of the evil of being penny wise and pound foolish. A few have been introduced into the South Sea fishing, but being entirely unacquainted with their use, and having had no opportunities of seeing their advantages, the prejudice is strong against them.

They are a great improvement upon Manby's apparatus for throwing a line to a ship in distress, a small line can be sent very correct nearly 300 yards, a greater distance than "Carte's" rockets can cover. We do not despair of seeing them extensively used both in mountain warfare and in grappling in naval warfare.

If the South Sea whale is what they report him, a ferocious animal, dangerous to approach, what so useful as the gun to give him a quietus at about fifty yards, for the lines used being much smaller than is required among the ice, there would be no difficulty in killing the largest with at most two shots. The method of securing the gun in a bollard on the bow sheets of the boat, is so simple and firm, that we have fired twenty shots as easy as with a fowling-piece. They are a most excellent gun for yachts,

for being placed on the taffrail, a most accurate aim can be taken at or near four hundred yards, with a bullet properly fitted. For any vessel carrying swivels, they are really worthy of attention. Government would find them as mountain guns, much more perfect and convenient, than anything they have in use, as they can be made to throw a one pound ball, and not to exceed fifty-six pounds weight, swivel, and everything.

An excellent *field* for sport exists on the coast of Scotland, during the annual visitation of the herring, in *hunting* the smaller whale, which hang upon the flanks of the immense shoals. What glorious sport to kill a fifty-ton fish, for those sportsmen who love novelty.



CHAPTER X

THE ARMS OF EUROPE AND AMERICA.

ENGLISH MUSKET.

A GREAT diversity of opinion exists amongst men, —who, in common parlance would be held to possess a thorough knowledge of the question,—as to the best size and weight of projectile as applied to small arms, namely, the musket and rifle. A mathematical dogma has produced considerable error; for anything appertaining to mathematics is generally received as truth, though only appearing on the surface; but calm consideration of the question, will

point out something is required to be tacked to the problem as it often educes an elucidation quite different from that superficial one generally adopted at first sight. Thus "the heavier the projectile, the greater the range and momentum or force," is one of these errors, causing the mind to lose sight of the truth to a certain extent. Projectiles are made heavy under the impression they will range further. We adopt weight as the advantage, while in reality we ought to say what is the greatest quantity of gunpowder we can fire without injury or unnecessary recoil; or in other words, what is the greatest power we can generate economically, and then ought to come the consideration, what weight will this force project, and at what velocity; for, we must clearly understand it is not weight that is force, but weight and velocity combined which gives us force, and consequently range. Therefore the mathematical dictum ought to be read thus, "The heavier the projectile and the *greater the velocity*, the greater the range and momentum." Velocity has hitherto been overlooked, but it is the germ of the principle. The point first to be considered, as all projectiles of whatever metal—iron or lead, or even denser metals—will all be dependant, in their scale, on the velocity given to them to effect their relative ranges. The olden opinion, that only a certain velocity was beneficial has exploded. Such is not the fact, as the advantage of much higher velocity then laid down

by Hutton, has been found easily practicable and of considerable benefit.

These few remarks bring us to the subject-matter of our Chapter,—the English musket and those of other nations. It has been somewhere said "you may always judge of the state of 'civilisation' of any country by its weapons." This too is a fallacy, if we construe it literally; for no doubt we have reached as high a state of civilisation as nation ever reached, but yet we have not the best weapons. We must be understood aright before proceeding further. Perfection, in principle, with us means goodness. We think mechanical structure, or beauty of workmanship, the second consideration; therefore, when we say, a better musket than the English, we mean one which will throw her ball further and straighter. The power to do injury at the greatest distance, ought to be and is, in all weapons of a projectile nature, the primary consideration. Few of our readers are probably aware, that there exists in practice with the English musket, no point-blank-range; in fact, the ball falls from the moment of leaving the barrel. If you fire a musket in a perfectly horizontal position,—assuming the average height of a soldier to be five feet,—we mean the level at which the musket barrel is held, at 130 yards distance, the ball will strike the ground. We have tried this a great number of times, by placing a musket on two rests an securing it there, even proceeding to the nicety of

levelling the tube of the barrel with a spirit level. The average of 20 shots was under 120 yards, having thus fallen, during this short range, 5 feet; and at trying at 200 yards it was necessary to give an elevation equal to 15 feet, and at 300 yards it required quite up to 50 feet; but, at this distance, their shooting, the possibility of hitting any size of target, is so difficult, as to be good shooting if you hit once in a hundred times, and if once done it arises from chance certainly more than skill, for their projecting powers are so uncertain, and influenced by so many circumstances, as to stamp the musket as the most unsatisfactory weapon in Europe. These defects are produced from two different causes. First, the size or weight of ball 1·06 oz. (if cast, but being pressed by machinery, is more than this) being too great. Secondly, the bore being 11 and the diameter of ball less than 14½, leaves full 3½ sizes for windage. We have proved a musket can be loaded and fired a greater number of rounds, by using less windage, from the simple fact, that each loading removes a portion of the deposit of the previous explosion. The second evil generated by too much windage, is that under no circumstances can anything approaching the full projectile power be given to the bullet. There is unoccupied a space in the tube, between the diameter of the ball and diameter of tube, approaching to one third of the whole diameter of tube. It is demonstrable, that more than this quantity must escape

past the ball, for we must allow that under all circumstances of velocity, the velocity of the explosion of gunpowder is vastly greater than any velocity that can be given to a ball; therefore, a great deal, we should think probably one half of the musket charge will escape past the ball during its passage up the barrel, not only expending the force generated but giving by its elasticity (first escaping on one side and then on the other,) a zig-zag flight to the ball, which it retains in a great measure to the end of its flight. It will also be comprehended, that if one third of the explosive fluid be confined, by having a ball fitting the tube accurately, that more effect would be produced than is in this case, at a waste of one half the power generated. Thus it will be seen, the excess of windage allowed in the English service, is productive of enormous evil. Few clearly comprehend the nature of windage, but most people understand the principle of a steam engine and the working within the cylinder of the piston, by the admission of steam, first at one end and then at the other; and which by its force drives the piston to the top of the cylinder, and then by allowing an escape of this power which has done its work, and the fresh admission of steam again at the opposite end, drives it back to the point from whence it started and so on. Now to any of our readers it must be clear, that if this piston was several sizes less than the cylinder or tube, that a portion escaping past

by that difference of size would expand again in front, after having past the orifice, and thus oppose its own force to the power of the other body, neutralising it in such a way, that the piston would not move at all, or if so, at only half the speed it would have done had that space not existed and the piston been equal in size to the tube. Precisely so is the English musket. During use the explosive matter escapes past the ball by the windage, and expands in front of it, neutralising the force generated to the extent at full one half.

We must always hold the proper intention of a musket,to be the power to project a bullet the greatest possible distance in a horizontal range or direction, so that the height or altitude of the flight of the ball, shall never exceed a certain distance from the earth, for instance, the height of a dragoon on horseback. Now the projection of all heavy balls, requires a corresponding elevation to enable them to be thrown to a given distance, from the fact that, if a high velocity be given to them to ensure a horizontal flight, the quantity of powder exploded must be in proportion, and the reaction of the gun, on the man that holds it also, will be increased to an enormous degree ; being thus clearly a simple mechanical question. If it take so much power to project a ball of one ounce weight 800 yards, it will require double the force to overcome additional resistance, and to project a ball one ounce and a half

weight the same distance. Consequently it follows, that there must be one size above all others, suited by a combination of circumstances, and by the laws of motion and force, to be projected the greatest range with the least means. It appears also that there is a size which meets with less resistance from atmospheric influence than others, and it is most clearly proved, by every experiment of the last five years, that all projectiles intended for long ranges, must present as smooth a surface to the atmospheric action as possible. We will begin with an experiment of considerable extent, which we carried out in 1841. At that period considerable excitement on the subject of military arms, and what they should be, occurred, owing in a great measure to the destruction of the small-arms department in the Tower, together with the immense armament contained in that depôt. It was thought to be a fitting time to agitate the question of improvement, and at the latter part of the year 1841, we published a series of letters in the "Times" on the subject (which will be found in the Appendix), urging the necessity of improvement. Although the correspondence continued in the Naval and Military Gazette, for nearly the whole of the succeeding year, little good was effected, so prejudiced are people. One incident certainly arose, which we thought would eventually have led to something conclusive, but we were disappointed. The circumstances were as follows. The

Board of Ordnance, actuated without doubt by the efforts we made to awaken attention, were kind enough to commission us to make two model muskets on our own plans and principles. These were completed and delivered to the Board with a memorial, praying that they would order an official trial of them against the arms as at present adopted, as we of course concluded a pattern of a musket was a secondary object, the range and force being in our opinion the matter of greatest moment. In due course of time, we received an order to attend before the select committee of adoption at Woolwich, which we did, and in accordance with our memorial to the Board, requested a public trial. To endeavour to describe the way in which we were treated, would not suit the pages of this work; suffice it to say, every thing we asked was refused, we were told, it would be a useless waste of money to expend upon any trial. This expense we offered to pay ourselves, but without effect. It appeared quite evident, they had made up their minds to refuse and reject every proposition made; in fact, treating us with anything but courtesy, and we left the room in disgust. On expostulating with the Members of the Board of Ordnance,—this select committee forming an integral part—we were told there was no appeal from their decision, and after addressing a long letter in the Naval and Military Gazette, to Sir George Murray, the Master-General, on the treatment we expe-

rienced, we threw up the question, conscious, painfully conscious, that however ardently a man may feel for his country's welfare, he may be frustrated and maligned, by those very individuals who ought to be the first to assist him in his laudable pursuits. Those interested, will find the whole correspondence in the Appendix. The experiments with these muskets were very extensive previously to our delivering them, and so satisfactory as to receive the high commendation of a large body of officers, who attended the whole course. One object, which has always been held to be of great importance to the soldier, a reduction in weight, was first attended to. A reduction of 2 lbs 12 oz. being accomplished without interfering with the strength or efficiency of a weapon as a pike. The bore was reduced to seventeen, carrying a ball eighteen to the pound, with great accuracy, and to prove that this was quite sufficient windage, eighty-five rounds were fired without the barrel being cleaned in any way. The old plan of musket could not be loaded except with great trouble, after fifty-four rounds. The trial was conducted by men chosen indiscriminately from the ranks of a detachment of the 61st regiment of infantry, and commenced at the ordinary target. At 100 yards, the number of balls which struck the target was three to one in our favour, at 150, as nine to two, at 200 yards, at six to one, and at 3C0 yards, ten balls out of twenty-five rounds struck the target

with the new musket; but the musket of the line never struck it at all—in truth, it was all on one side. On the same occasion, we endeavoured to ascertain the extreme range of the government arm, and though a great number of rounds were fired we could never get one quite up to 900 yards, and this with as high an elevation as fifteen degrees. The average of six shots at ten degrees, gave a range with the new weapon of 1385 yards, nearly 800 yards further than the regulation arm. The charges used were the regulation cartridge of 4½ drams, for the regulation musket and cartridges of 4 drams for our improved arm. A course was then begun to ascertain the penetrating power of each ball, and a quantity of elm boards were obtained to assimilate it to the practice in the arsenal at Woolwich, and here also it was found an advantage existed of above 30 per cent. in our favour. In short, every way that could be supposed likely to lead to a further knowledge, was adopted, and with a like result. It will be strictly unprofitable to detail all the "et ceteras" of such a trial, but we may glance at one most important feature, holding it essential that all military projectiles should have as near a horizontal range as possible.

We tried a course on a sheet of water, firing perfectly horizontally from a rest, with the aid of a spirit level. The first distance at which our musket ball struck the water, was 260 yards from

the muzzle; that of the line-musket averaging 126 yards. The extreme range after recochetting on the water several times, was 1216 yards, that of the regulation 684 yards, a disparity so great as to admit of no dispute. Thus we have placed before the reader a comparative case; here is one of the present adopted muskets containing all the improvements that Mr. Lovell has added since he obtained the control of the small arm department, and here is a musket nearly 3lbs. lighter, projecting, with greater comfort to the soldier, a ball 600 yards further. To speak of the two in the same breath, would be ridiculous. Here is no exaggerated case. On the truth of our statement, we pledge all that is dear to us "*our reputation.*" A vast deal of matter on this point might be added, but as the discussion created at the time, is all added to this volume, the reader will find every point fully open to him. The mechanical arrangement of all our military arms is of the most rude and antiquated nature. One of the most importance to a percussion gun, is the lock, for all perfect detonation is dependant on the smartness of action in the cock striking the cap on the nipple. An immense pressure is not effective. In producing detonation, it appears to be most clearly developed when brought out by the smartest action that can be obtained; it also appears to be greatly increased in force by that fact; in every experiment we have found it to increase, the sharper

the percussion applied to it. Therefore the necessity for a sharp clear actioned swivel-lock is imperative. But yet in spite of the experience of many years, the universal adoption of the swivel, in even the commonest description of locks — those produced at a trifle each, is, or ought to be evidence of the most complete nature in its favour. The old plan of hook tumbler is so rude, partakes so much of olden times, that we wonder if the advocates of it can really have been spectators of the improvement of the last few years. The swivel-lock is friction reduced to a "minimum." The old hook-tumbler and main-spring, is friction at its "maximum." Even in the old flint lock "era," the action of these two *inclined planes* was found to be vastly too slow, but their continuance for percussion guns argues their advocates to be only "*out of their proper sphere half a century*." There is something so extremely ridiculous in all the arrangements of the select committee, and their inspector of small arms, Mr. Lovell, that we frequently think they have determined to adopt nothing we have ever spoken well of, for it is quite clear they are at a "non plus" to find a reason for their obstinate adherence to the barbarous tumbler-lock. Cost, can be no objection, as we are fully satisfied one could be produced as low as the other, but the principal forte of this inspector appears to be in producing as "*outré*" an article as he possibly can. A waste

of many thousands of pounds has taken place under this management.

On the spring to secure the bayonet on the barrel, there has been at least five different plans, and as many failures; and the last production is so exceedingly inelegant, as to be termed "*Lovell's improved papspoon spring.*" The French and Belgians, have a very simple plan of securing the bayonet against the possibility of its being displaced by the blow of any sword; and it is merely a loose ring moved in a given direction, when once the bayonet is fixed, locking it by the bayonet stud on the barrel, a much more simple and a much more efficient plan then ours. It is but a dry subject, and with one more point we will pass on. The love of change, if so be—Mr. Lovell can only add his name to it, seems to be his "rock a-head." He has lately altered the good old plan of securing the cock on the neck of the tumblers by the square; he does not like what is "square," and as an improvement, he fits the cock on round, drills a hole in at the joint, and "keys on" the cock in the same way a wheel or crank is "keyed on" to the pulley or shaft of a steam-engine. This he has the modesty to think is an improvement. We are sorry at not being able to agree with him. To sum up the whole as briefly as we can, we say, that in no private individual establishment would such proceedings be tolerated,—in no private establishment

would Mr. Lovell's talents keep him a month save behind the desk at his ledger, and this his legitimate employment he should never have quitted. There exists a curious anomaly in the getting up of the government orders for arms. We have contractors with no risk, no obligation, no duties save attending to receive their monthly accounts and paying what is due to their men. This appears to want explanation, and we will endeavour to explain. A certain quantity of arms are required to be manufactured in Birmingham. Before the orders are issued, the prices are fixed at which every department of the work is to be done. The men know this to an item. It is also required in each stage to be taken to the viewer at the government warehouse in Birmingham, now entitled the Tower, and if correct, he passes the work, if faulty, he condemns it. If he does the latter, the loss falls upon the workman, and this is the case in every branch of the manufacture. Therefore the contractors have no work, the viewer takes that from them. What use they are we really cannot discover. There are a great number of contractors—even some have double contracts,—it seems strange such a thing should be, a contractor without a risk or duty. A proper system of contracts, a responsibility on the contractor, a risk of having the finished gun rejected, would compel them to inspect the manufacture in every stage.

In the present government arrangements, the ex-

cessive nicety observed is productive of no good. It is in reality a waste of money. A very good, *sound*, *strong*, and sufficiently well finished musket, could be made by contract at £2.; equally good in every practical requirement, to the line-musket of the present day, which when all is considered, does not cost the country less then £4. 10s. each. This unwarrantable expenditure is, we can show, perfectly useless, perfectly unnecessary, and has been brought round by the incapacity of the small-arms inspector. For feeling his want of knowledge, and not knowing exactly where to stop in quality, not feeling confidence enough to recommend only such and such a quality of gun, but to conceal his want of skill in gunnery manufacture, jumps to the very extreme, and requires a line-musket to be got up with all the nicety of a thirty-five guinea double gun, all the unmechanical arrangements in the lock and barrel, are made up in extra nice work in the stocking. It reminds us of the setting the "*tawdry paste*" in the fitting of the diamond. This is a point we would submit to every gun-maker (worthy of the name) in the kingdom, and they will one and all agree with us,—that an expenditure of forty shillings on every musket would be amply sufficient; but then there must be a disbandment of the vast "corps" of viewers; for no spirited man, knowing his trade, could be subjected to these worse than "jacks in office." It is a system liable to

very grave objections. One of the most glaring is the "Palming System." Some men can pass any sort of work, while other and better workmen, are subjected to extreme annoyance and loss. A very singular case, injurious to Birmingham in a pecuniary point of view, occurred three years ago. The Russian government wished to have 15,000 arms on the model of our military rifle, manufactured in this country; and applied to the Board of Ordnance for information. They were referred to Mr. Lovell, and we have reason to know, that his representations induced them to give the orders in "Liege," where we saw them in progress eighteen months ago. The substance of Mr. Lovell's communication was, that they could not have them made in Birmingham under £5 each, and that they would experience great difficulty in getting them up. We presume to think we know vastly more of gun-making then Mr. Lovell, and have no hesitation in saying an excellent profit could have been realised upon them at £3 each. In truth we could make them sounder and better than they were done in "Liege" at £3 each;—so the people of Birmingham have to thank Mr. Lovell for the loss of this order. We cannot help thinking that Mr. Lovell saw that it would be likely to draw off his best men, as the "Tower work," as it is technically named, is far from being popular. In a national point of view, high prices, or, an article too good for the occasion, is money clearly thrown away,

and in a case of a sudden demand calling for the supply of half a million stand of arms in a short period, the men having been so hampered in getting up their work so unnecessarily well, it would be long before they could suit themselves to the style of inferior work. All that is required in a military musket, is a straight well-bored barrel, good iron and well proved, a lock strong, plain work, but best materials, and above all things involving the best principles in its construction. The French nation could arm 300,000 men, at less cost than we our 100,000, and a great deal better, as will be understood on perusing our remarks on the French musket. A great many glaring deficiencies we have passed over here, as they are so fully embodied in the letters published a few years ago, and re-printed now in the Appendix. To repeat them in detail again would be a useless labour.

That our arms are what we represent, we will adduce a recent instance,—the attack on H. M. brig Fantome, by some pirates in the Mediterranean, —in which action it is stated a lieutenant was killed owing to our arms not ranging half the distance of those the pirates were armed with. What a lamentable sacrifice. If but one life in fifty years be sacrificed, we should still be culpable; we, the *elite* of the world, the pioneers of science, the most skilful manufacturers of the best guns in the world, to permit our defenders to enter the combat worse armed

than many of the most barbarous of the nations with whom we have to contend. Look at the Affghan war,—remember the Khyber pass—and the deliberate slaughter of our troops by the rude but efficient projecting weapons of these ruthless tribes. They were of the rudest structure, a match lock and all the clumsy attenements, yet their *range was vastly greater than ours*; nor is it to be attributed to their gunpowder, for that was not better than ours, we should think, from specimens we have tried. It has not more than two thirds the projecting power of European manufucture; then the question settles itself to this "*It is the projecting power being in exact proportion to the weight of projectile*," a knowledge no trouble has been taken to obtain by our Government, as we have already shown; and it is quite clear, until a radical change is effected in the selection of the individuals who decide on the improvements necessary to be introduced into our *projectile practice*, no efficient good can be effected; give us men with at least a little science and mechanical knowledge, men divested of prejudice and exercising discernment, men who by their actions and labour prove that they do in reality possess ability. It is wrong, very wrong indeed, to suppose that because officers have been educated at the cadet school in all that appertains to the crude undigested principles of gunnery as understood 50 years ago; men, that have since then passed by gradation to be

colonels or majors of artillery should, as a matter of certainty, possess all the knowledge requisite to enable them to decide on inventions very frequently possessing the germs of intricate science, and as such far removed above their usual studies, and of course difficult to comprehend. It will we know be considered very harsh and ill-natured to speak thus of men, who from their rank and education should pass "*muster*" as equal to the elucidation of any "*knotty science.*" But we have allowed these claims of *precedency* to exist too long; we should care not what be the rank of a man—is he capable of deciding a question on which not only the progress of science may depend, but on which it may be the national welfare is bound up;—if he be not equal to this, away with all claim of *rank* or *precedency*. A nation's welfare cannot be entrusted to *incompetency*. We would be sorry to attempt to individualise the members of the "*Select Committee of adoption*," but we know several, (read the letter addressed to Sir G. Murray, in the Appendix,) and on giving an opinion that they are totally unfit for the task, we are only repeating what we before stated. Since then we have watched intently all their proceedings, we have tested their works, and they all prove they possess a small share of mechanical, but a much less share of scientific knowledge, incurring a useless waste of the nation's money in experiments that could lead to no beneficial results, but the effect of

which could be pointed out to them by the merest "tyro" in science. We will adduce one instance. There exists an inveterate hatred towards "civilian inventors" * on the part of these military "inventors;" whether proceeding from the conviction, that the former have effected every improvement yet at-

* TO THE EDITOR OF THE PATENT JOURNAL.

SIR,—As I perceive by the daily papers that several members of the House of Commons have taken upon themselves to lecture Capt. Warner for not making his discovery known, and trusting to the *justice* and *liberality* of the Board of Ordnance, I will endeavour, through the pages of your widely circulated journal, to explain to inventors what this *liberality* is, by a simple statement of facts, the truth of which I can prove.

About five years ago I discovered the mode of making a shell, the power of which was enormous, viz., about 8000 times that of gunpowder, and as I found that the manner of using it, and also the effects produced, were exactly similar to Capt. Warner's shell, I concluded that they were the same in construction. At that time Capt. Warner had the subject before the House of Commons; I therefore rather than injure him, kept my discovery secret for two years, till the House of Commons had refused to entertain Capt. Warner's request. I then made application to the Master-General of the Board of Ordnance, the result of which was, that I, "at my own expense, was to furnish that Board with a full description of the process of manufacturing the shell, and the manner of using it, together with such drawings and models as I might consider necessary for the perfect understanding the invention." This was done. I then had another letter, appointing a day on which I was to appear before a committee appointed for the purpose, at Woolwich to answer questions, &c. I attended the Board; and here let me mention an incident that greatly influenced me when before the committee. While I was waiting on the landing outside the committee-room, an officer, with rather a loud voice, asked, on my name being mentioned, if I was another of those "d—d civilians,"

tained in gunnery, or from envy at their "superior" inventive faculties, we know not, nor do we care, but it does exist to a self-debasing extent.

As soon as the "prophecy" of a gallant colonel that "Monk's' was a dangerous gun" was proved to be no prophecy at all,—"spite of repeated trials—in firing her as a mortar at as high an elevation as the carriage would allow." A race of competition began, and "ergo" says one, if a 56lb. ball can be thrown 3½ miles, certain a 68lb. ball can be thrown further, for "weight is power." (One of the best experiments

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and on being answered in the affirmative, he exclaimed with an oath which I will not repeat, "What the devil business has he to interfere with military matters?" A laugh followed, and then I heard, "Poor devil!" I was shortly afterwards called in, and asked several questions, which I answered; but from what I had overheard while outside, I was predetermined not to explain a few *trifling* circumstances, without a knowledge of which, *no one could make the shell with safety*. Before I left, the committee *promised that if anything was done with it, I should be employed to superintend the experiments.*

About three months afterwards on going to a manufacturing chemist in the city, where I was well known as an experimental chemist, but *where my name was not known*, I was asked if I would make for them the very substance used in making the above shells, and on expressing my surprise at the request, and asking why the question was put, I was told that the officers of the Board of Ordnance were trying experiments for the government on the substance I had named! and it was added that it was desirable to keep the matter secret. After this I am sure no one can blame Capt. Warner for not throwing himself on the justice and liberality of government authorities.

I am, Sir,

Your very obedient Servant and Subscriber,

F. H.

ever tried to prove a negative.) Well, influence and rank can ask for the expenditure by the nation of thousands of pounds in constructing 68 pounders, (but in our case we only asked the expenditure of about thirty shillings, yet the sum was of consequence, though we went to prove we could save the nation thousands in a year,) well, the story must have an end, 68 pounders were made in all drawings and models light and heavy, and 68 pounders were tried with charges of powder to such an extent as to *create well founded alarm that the stock of saltpetre would become exhausted*, but yet 68 pounders would not throw a ball 3¼ miles, nor indeed within three-quarters of a mile of that distance, so much for the "Dundass" versus "Monk" guns.

One story leads to another, more especially as they may be in a measure linked together; one failure should never damp the energetic, "perseverance is commendable," (as we wrote when at school), what odds, as well try a 56 pounder as any other, and a Dundass 56 pounder has been constructed, has competed, is competing and will unto the end of the chapter. It may interest the reader to know the difference between this adoption of Colonel Dundass—to call it a discovery would be an insult to his genius we feel sure—the difference in the drafts of the two is, Dundass's gun is *6-10ths of an inch longer in the hole*, *6-10ths of an inch less diameter across the breech of the gun*, *6-10ths of an inch greater across the fore part, something*

very magical in six tenths of an inch. The report is so far equal, they have to compete (together with a production of the Navy Board, a sort of medium) *unto the death*, i.e. until they burst, and should it happen that they both by management do so; why to be sure the production of the "Hydra" will bear off the prize. To speak of this in the calm of the philosopher, is to argue on a foregone conclusion which we do not aspire to, and consequently we speak as an ordinary mortal. More disgraceful, more dishonourable conduct, has never characterized the British service. Here a talented man drafts a gun on purely scientific principles, obtains, after repeated applications, an order for construction. It is completed, tried, and found to range more than a mile greater than any previously constructed. There is a principle gained—a *bonâ fide* acquisition of power as demonstrable as that the "Thames" ebbs and flow. Well, what in justice, ought to have followed this. A recognition by the government of the invention, a reward ever so small, "genius seldom cares for money." No,—the inventor is a civilian, and he must be subjected to fight a battle of years with any military man who can club up a concatenation "of ideas sufficient to make a decimal of a principle." We wonder that a man of the high honour of the late Sir G. Murray, permitted this for a moment; we believe he could have never known it. It is not this case alone we adduce, another is named

a few pages past, but it is the universal treatment of every civilian. We may be presumed by some of our readers to be what we ourselves complain of frequently, namely, "prejudiced" or more probably actuated by friendship. We solemnly declare, neither. Mr. Monk we never saw to our knowledge, most assuredly never exchanged a word with him, "We do admire him," we always admire "genius" We detest the "pretenders to it," and here lies the whole secret. Mr. Monk has made the greatest practical improvement in gunnery ever achieved—a mechanical and scientific discovery, which, not many individuals in the queen's service can as yet comprehend, the "rationale," though as apparent as possible; and when the trial is completed, we will point it out to the world. It would be unjust to the inventor to do it sooner, as all will join in the cry, "we know that as well as you." Nothing can cause Monk's gun to fail, but unfair play. It is as impossible as to upset any of the oldest established principles.

Strange, but not more so than true, the inventors (for there was more than one) of the rifle, knew more, and practised it too, of the principles on which the rifle is constructed, than we do at the present day. Science, with all her strides, has not taught us the beautiful development of principle the well made rifle contains; but, like many other splendid inventions in our wish to improve, we *stride* over

all that is good and capable of extension, and adopt that which is doubtful, and imperfect; how many excellent ideas have been laid on the market of competition, submitted to the judgment of the self-styled philosophers. The gentle scanning of the surface, not displaying to their limited capacity the riches of the interior, it is discarded, and pronounced not good, because the intellects of the judge were not capable of grasping the merits of the invention. So is it with the principles of the rifle; few, indeed, can tell you what is the intention of the grooves in the barrel; all know that the furrows and lands are intended to act upon, or to influence the ball somehow or other; some know a little further, the intention of the spiral grooves is to give the ball a spinning motion coincident to its flight, or in a direction parallel to the line of direction; but ask one of these *philosophers* how oft the ball should revolve on this axis, during its progress through the atmosphere, how many times it should turn in one hundred yards, why, you might just as well ask them the hour, the minute, Halley's comet would appear again. But without they can tell you this, they know nothing, or ever will, of the principles that regulate, or ought to do, the construction of the rifle. We have rifles the most *outre*, the most barbarously arranged fire-arms of the present era, mere machines, constructed to generate explosive force, with an accumulation of obstructions, only intended

to waste the power generated, and thus becomes the means and the end, the producer and the destroyer, the fabricator of an internal power, that never can become perfect from the impediments to its escape.

The inventor or inventors of the rifle intended it to become the most perfect of fire-arms, and so it would, had not the over-weaning knowledge of man marred that intention; a vain opinion, that never will benefit the human race, instils vain minds with a belief that they are benefitting their generation, while, in truth, they are its greatest enemies; and the improvements they fancy they are effecting, become the greatest drawback, on the original intention, that can possibly be imagined.

All experience teaches us that the intention of the whirl on the axis is to give to the ball an equilibrium of resistance, opposing all parts of the half sphere of the ball in rotation to the action of the friction of the atmosphere, and it further teaches us that this atmosphere being an existing evil, we have here a means of neutralising that evil, and having obtained this, we must not create a greater, by giving to a ball three turns on that axis, if one will suffice, for the superabundance of two will destroy the advantage gained by one, and thus we had better have been content with the plain barrel. From the peculiar nature of the powder of the ancients, the extreme spiral given to their grooves was required;

the velocity was trifling, compared with what it is now, and a ball would turn with these spirals; but experience would or should teach us, that if one complete turn in three feet long was the state of perfection when powder gave to balls a velocity of 2000 feet per second, much less than this should be adopted when the velocity is doubled, for the ball has to turn the same in half the time. Can it be possible that a ball of 5-8ths of an inch in diameter, or one and 7-8ths in circumference, will turn one hundred times on its own axis in one hundred yards, or the zone of the bullet travelling 187½ inches further than the axis, without this additional friction on the air lessening the velocity, and thus the range of the projectile. Then, how much more will this resistance influence a ball where velocity is greater; velocity means force, force means the penetration of the air. Give to a ball a velocity of 3000 feet per second, and it not only reaches the goal in half the time it does where the velocity is 1500 feet per second, but it will be deflected from a true line less, as the currents of air and attraction of gravity have less time to act. Therefore, it becomes clear that to cause a ball projected with a great velocity to spin equally with a ball of medium velocity, is creating a useless speed, because destroyed by that spinning without obtaining any advantage; velocity is only capable of flying straight, you cannot give a ball this peculiarity,

and retain with it a zigzag motion; it is contrary to all established laws of motion. These few remarks will bring us to the present state of knowledge on rifle making; for we have lately had a complete innovation on all old established rules, in regard to the construction of which Robins says, "Whatever state shall *thoroughly comprehend the nature* and advantages of rifle pieces, and having facilitated and completed their construction, shall introduce into their armies their general use, with a dexterity in the management of them, they will by this means acquire a superiority, which will almost equal anything that has been done at any time by the particular excellence of any one kind of arms, and will perhaps fall but little short of the wonderful effects which histories relate to have been formerly produced by the first inventors of fire-arms." How straight a path is here pointed out, and, in truth, he saw the principle of rifles so clearly, that it would be a manifest injustice not to quote his writings, as they abound in science, and true science too; he says, "But it is now time to mention the varieties of these pieces, and the different methods made use of in different places for charging them.

"The most usual is doubtless what I have described, that of forcing a leaden bullet down the piece by a strong rammer driven by a mallet. But in some parts of *Germany* and *Switzerland* an improvement is added to this practice, especially in the

large pieces, which are used for shooting at great distances.

"This is done by cutting a piece of very thin leather, or of thin fustian, in a circular shape, somewhat larger than the bore of the barrel. This circle being greased on one side, is laid upon the muzzle with its greasy part downwards, and the bullet being placed upon it, is then forced down the barrel with it, by which means the leather, or fustian, incloses the lower half of the bullet, and by its interposition between the bullet and the rifles, prevents the lead from being cut by them. But it must be remembered, that in those barrels where this is practised, the rifles are generally shallow, and the bullet ought not to be too large." Here is the germ of the science clearly displayed, even at that early date, for if the lead is cut by the rifling, the action of the atmospheric fluid will be so great upon it, as both to prevent its spinning, and to influence the length of range, the fustian or leather receives the action of the spiral grooves, and communicates to the bullet a certain portion of that "*whirling motion,*" without the zone of the sphere being at all indented. Robins further says, "From all that has been said then, about the use of rifled barrelled pieces, it is sufficiently obvious, that whatever tends to diminish the friction of these pieces, tends at the same time to render them more complete, and consequently it is a deduction from thence, that the less

the rifles are indented the better they are; provided they are just sufficient to keep the bullet from turnning round in the piece. It likewise follows too, that the bullet ought to be no larger than to be just pressed by the rifles, for the easier the bullet moves in the piece, supposing it not to shift its position, the more violent and accurate will its flight be." Robins saw further into the principle of rifles than he is accounted to receive credit for. Plain and straightforward as his elucidations are, and so clearly established too, that considerable wonder arises how it is that more attention is not paid to his theory; men depart from well-trod, and beaten tracks, to penetrate the mazes and brambles of the forest, from a wish for singularity and notoriety; how plain and how clear the doctrine of expulsive force, "for the easier the bullet moves in the piece," the greater, unquestionably, will be its range, as whatever tends to increase the load the powder has to lift, destroys a portion of that force, and hence the velocity of the bullet, therefore, again, true science says to us, obtain the most with the means, do not require a bullet to spin twice on its axis, if once is sufficient for the purpose required.

The shallowness of the grooves is a part of that principle, the absence of which would render the whole imperfect for two reasons, allowing the escape of the explosive propellant by these grooves, and the necessity of an increased number, so that the

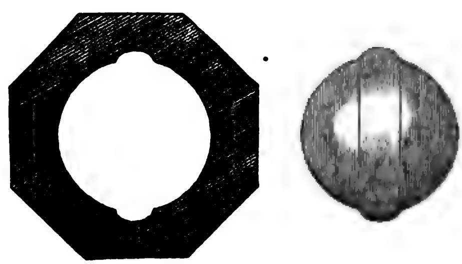
quantity of threads would effect a greater hold of the cap of fustian, and in so doing, a greater power in giving the spiral *whirl* to the projectile. The disrepute the old plan of loading at the breech, by unscrewing a piece in the side of the barrel, fell into, ought to have taught the rifle manufacturer of the present day, the inutility of fabricating rifles with a necessary projection on the ball as unscientific and inferior, and a returning to obsolete practices, which had been clearly proved to have been discarded, solely from a conviction of their great inferiority; no rule, but a wrong one, can be advanced to prove, that there is a particle of science to be found in the vaunted plan of the present day, but that it is merely an alteration for the sake of alteration, a change, "for they are sometimes lightsome," a wish for notoriety, mattering not how obtained, whether raking from the graves of bygone ages, or stealing the efforts of more modern ones. Vanity and ambition prompts mankind to take whatever he can, if there is no penalty attached to the taking, and what so easy to take as the brains of the dead. Inventors; bah! men advocate a return to the plans you have left, rather than to advance to further discoveries, because they are unfit to lead, denotes how science is cultivated. "Full many a flower is born to blush unseen," is not their case; but like hedge nettles they spring, and by their growth, smother and hide the "lowly

violet, blooming sweet," and by fulsome rank pretence, fill the atmosphere with unpleasant odour.

The directors of the military affairs of this great nation, too, encourage the growth of impure science: possessing but little themselves they cannot discern the pure from the alloyed, and presumptuous assurance with them finds most protection. It is untrue that England is the home of the arts—she is the nestling place for the "mocking bird," the imitator alone finds credence.

To talk of science being displayed in the principle of the rifles they have made to arm England's brave sons with, is to say base brass is gold—the glittering paste a gem. No; the only science existing in them is to be found in the imagination of the projector, and the men who have praised the production; but it were folly to waste the reader's patience in perusing a tirade of abuse upon the system that encourages this worse than waste of the nation's money. Tell us not that men use these arms to greater perfection than the others: but first tell us, were they ever taught the use of them, and whether the only improvement is not alone to be attributed to the extra means taken to make them better shots by additional practice, so that this *spurious* improvement may hold its place? "'Tis even so." But, however, to describe this monster in science. "The intention in all rifles," says Dr. Ure, "is to impart

to the ball a rotatory or spinning motion round its axis as it passes out through the barrel. The object was attained to a certain degree in the rifles of the old pattern, by cutting several spiral grooves into the inside of the barrel, in the manner shown by *a*, the spherical ball *b*, being a little larger than the bore, was driven down with a mallet, by which the projecting ribs were forced into the surface of the ball, so as to keep it in contact with their curvatures during its expulsion. Instead of this laborious and insecure process, the barrel being now cut with only two opposite grooves, and the ball being framed with a projecting belt (as below), or zone, round its equa-



tor, of the same form as the two grooves, it enters so readily into their hollows, that little or no force is required to press it down upon the powder, yet so much more hold of the barrel is at the same time obtained, that *instead* of one quarter of a turn, which was the *utmost* that could be safely given in the old way, without danger of stripping the ball, that a whole turn round the barrel in its length can

be given to the two-grooved rifles. The result is that better practice has been performed at three hundred yards, than with the best old military rifles at one hundred and fifty yards. This mode of rifling, however, is not new, but, in fact, one of the oldest upon record, and fell into disuse from faults in the execution. The idea was revived in Brunswick, and in Hanover also; but the judicious improvements it has received in Mr. Lovell's hands have rendered it, when skilfully used, a weapon of unerring aim, even at the prodigious distance of *seven hundred yards.*" To suppose Dr. Ure can possibly be the means of puffing a doubtful plan, is to suppose the doctor to be what he is not; but that he has taken all this upon trust, we cannot help believing; and he having attached his authority to it, by praising it, is sufficient admission of paternity, for what Dr. Ure states, from his known abilities, is, of course, received, and becomes an established theory. As we cannot, however, subscribe to his conclusions, we shall show the why and the wherefore. In the first place, he states, "It enters so readily into these hollows, that little or no power is required to force it down." When the barrel is clean, little force will be required, but how will it be when the barrels get dirty? One peculiarity of the old plan is, that you use a greased patch, and this partially cleans the barrel every time. The doctor does not mention the use of any patch here; then

where will be "the little force necessary?" After twenty shots, the gun will be found so foul as to require *greater* force than ever is required by the old plan, where a partial cleansing takes place. We have used a two-grooved rifle oftener than we should suppose the doctor ever has, and we find the obstruction from this cause so great as to require a heavy rod to force down the ball, and frequently in doing this the belt or zone is completely cut off. Wilkinson says, "in all cases a well greased patch of calico should be used, cut either square or round, and large enough nearly to envelope the ball; this is essential to all rifles, as it is easier to load, diminishes windage, prevents the barrel from *leading*, (query, fouling), and increases accuracy of flight." Then how much easier will it be loaded? not so easy, we assert it: again, "yet so much more hold of the barrel is at the same time obtained, that instead of a quarter of a turn, which was the utmost that could be given in the old way, without danger of stripping the ball, that a whole turn round the barrel can be given to the two-grooved rifle;" and does Dr. Ure think this a benefit, (a full turn in two feet six inches being the military regulation), a spinning of the ball nearly one and a quarter times in every yard of distance, the outer surface of the ball thus travelling 190 inches in every 100 yards more than the axis, can this be obtained without a waste of powder in even a spherical ball, but what

must it be with a two-grooved ball; two projections (equal to one-fourth the diameter of the ball) cutting the atmosphere to such an extent as to invariably induce the projections, and influence the ball to change its axis from that of coincident to the line of flight, to an axis perpendicular, or the reverse of that intended, this we have proved to the satisfaction of many who have joined us in experimenting on it, and who can prove it if required. The extreme spinning motion is thus got at a sacrifice of explosive force, of velocity, and as we shall clearly show of range; can it be possible for any one with the acquirements of Dr. Ure to read either Robins or Hutton, and who possesses any knowledge of the action of the atmosphere, not to know that such a result must undoubtedly take place on any projectile with this extreme motion on an axis. The original inventors found its defects. The Germans and the Swiss found that projections on the balls influenced the range and accuracy, and hence their disuse. We used projections cast upon balls to fit the grooves of a rifle accurately, eighteen years ago, and we discarded them, because we sacrificed range in using them. We had as many as eleven projections round the zone of the bullet, and their action would be more uniform and less in effect than where there is only two, and consequently at a greater distance. The trifling spiral used in the old military rifles is on the very opposite extreme, and as such with the

slow exploding military powder were comparatively of no use, and would never strip the ball, but jumping to the opposite extreme is not the most judicious way of remedying the defect, especially when the change is accompanied by the addition of percussion to rifles also; that alone would have increased the accuracy of the old rifles, as velocity must increase the chances of perfection.

The result recently obtained by Mr. Lancaster, in ranging a rifle bullet 1200 yards with wonderful accuracy, establishes our theory most conclusively, and proves the correctness of the view we took eighteen years ago, and which we have just narrated, as it was in every respect the same as performed by him, only we used projections on the ball, he does not, but makes it to resemble a sugar loaf with an indented ring round it, which is filled up by lapping with thread and saturating it with grease; having two beneficial effects, tightening the ball in the tube without unnecessary friction, and partially cleansing every time of loading. The peculiarity of shape we do not value, as it has no influence on the range, at least very trifling, as we can obtain, and have done so, a greater range with a spherical bullet from a plain-bore musket, and the French with their new rifle, range 1500 yards with a perfectly spherical ball, about the weight used by Mr. Lancaster; so that there is nothing new in the range, and the principal matter for admiration is the very wonder-

ful shooting—hitting a target of 81 square feet, 6 times out of we understand about 30 shots, is a great result, as it must be apparent, a number of shots would be expended in obtaining the true elevation. Having obtained the particulars from Mr. Lancaster, we have pleasure in making this acknowledgement. The length of rifle he used, is 2 feet 10 inches, with a quarter turn of spiral, the charge 2½ drams of powder. Elevation, by fixed sight, gives 8½ degrees. This is so near the result of the Belgian experiments detailed elsewhere, and the coincidence of the French coming so near the same, establishes the correctness of the whole experiments, and must be gall and wormwood to the parties who advocated and obtained the adoption of the two grooved rifle as that of our government. What a comparative result, a full turn in 2 feet 6 inches, with a charge of 4 drams, giving a range of 700 yards, and on the other side a quarter turn in 2 feet 10 inches, and a charge of 2½ drams, giving a range of 1200 yards. Where can Mr. Lovell, and his scientific party hide their heads? We should suppose they will not again trumpet forth their *extreme* knowledge of the law of projectiles. But alas! the difficulty does not end with the mortification these men must feel—what is the country's situation? where are the many thousands uselessly expended on the most unserviceable gun in Europe—five pounds each for a gun that will not range 800 yards,—while the

French rifle costing only 36 francs, ranges 1500 yards. When will this cease—when shall reason take the place of pretence,—when will those who hold the nation's purse strings, ask what is the money for? The East India Company too have been "bamboozelled" into the adoption of this abortion of science. Now we ask, does not our warning given them in 1841, ring in their ears? Mr. Lancaster has conferred by this experiment the greatest benefit on science. We only wonder how as a civilian, he could ever obtain the consent of the select committee. They must have calculated upon his being a "civilian," "pretender," or they would certainly have perceived, that as the party recommending the adoption of the two grooved rifle, they were to "stultify" themselves, consenting to be proved in error. The only object we had in view in 1841, was to obtain an official trial, to show the world and have these individuals vouch for it, that we would range a ball twice the distance the present military musket would range; but no, on this occasion they were not to be convinced, and have at last been fairly dragged from their "earth." The one consequence of this enlightenment, is to be a re-trial of a rifle cannon proposed by the late Joseph Manton, which has quietly reposed upon the shelf for many years. We suppose a few hundreds more of the nation's money will be expended on re-experimenting with this gun, the principle of which none

of them understand. This peculiar shape of ball is extremely old,—an engraving of it exists in a work called "a True Light to the Art of Gunnery," by Thomas Binning, published in Edinburgh, in 1626. It also contains an engraving of the two-grooved rifle ball, applied to mortars. Any advantage it possesses, arises from the momentum and the small surface presented to the atmosphere; but it decidedly is not constructed according to mathematical rule, as the centre of gravity instead of being near the foremost end, is the reverse, and will be apt to change its axis more especially when the bullet has reached the greatest altitude in the parabolic curve, and in its downward flight. We would strictly impress upon our readers the science in this experiment, and remark that this is not an isolated experiment, as the French do more every day at their Normal School, at "Vincennes." The Belgians did the same at Antwerp, in an experiment extending to 44,000 rounds in 1844, and among the rifles used in this experiment, was our two-grooved military rifle which was declared to be the worst rifle tried. The absence of friction is the principal advantage, velocity is the next, and the small amount of spiral once in four yards, is sufficient to give the ball a motion on its axis, to that extent, and yet not sufficient to materially impede its flight, but that it does there can be no doubt as a plain barrel will range further, but wanting the motion on an axis (parallel

to its flight,) is not projected with anything like accuracy. Therefore it will be perceived, and must be received as an infallible axiom, that no rifle with more than this degree of spiral, will nor can be expected to range any thing like this distance. The ordinary standard of spiral, one turn in 4 feet, is suited for ordinary rifle shooting at and under 300 yards; because, here you use a charge not sufficiently great to cause recoil; as it must be apparent that 2½ drams is more than would be convenient to use in anything but actual warfare: therefore it would be very unwise to change your old principle of rifle for one suited strictly for warfare. Here it must come into use, for we cannot be expected to compete against soldiers armed with weapons of double power to our own. Such a state of things will not be permitted to exist by the British nation, and we hope the question will be so agitated in the Houses of Parliament, as to compel some beneficial alterations; for assuredly the arms of England are the food of laughter for the whole military of Europe. The want of system of instruction to the soldier, in the use of his weapon, is and must always be a great drawback to the British army. Bad as his musket is, he might be taught something, to fire it horizontally. But this most essential point is in no way attended to. Notice any regiment firing in line: take the guards, the crack of the army, and notice them attentively, and you will perceive the

direction of their muskets resemble a "*chevaux de frise*," some up, some down. In answer to this observation, we have been told this is only the case at parades or reviews. Well, be it so, but the other case is as easy of attainment and if so, teach the men aright on parade, and they will not forget their instructions when before an enemy. The French are not leaving these things to the soldier's discretion.

To quote Dr. Ure again, "The result is that better practice has been performed at three hundred yards, than by the old plan at one hundred and fifty yards." The extra schooling the soldiers would receive in trying these *improved rifles*, is a sufficient answer, and we might leave the question there. But science requires elucidation. The quarter of a turn in the grooves of the old flint rifle might and would shoot better with a percussion lock than a flint, and *the considerable change* is never taken into consideration. Government rifles never were constructed with the slightest attention to scientific principles, nor it appears ever will, but that ought to be no ground to puff an equally unscientific plan on; it is quite unfair, and contains no sound argument. The rulers of a great nation like this, ought to see the defenders of their country armed with the most perfect arms that can be produced, and not with an article full a century, *nay*, "*near three*" behind the age. Dr. Ure ought to know that a well constructed rifle at 300 yards throws her ball so accurately,

after deducting casual circumstances of wind, &c., so true, that it is impossible to excel. A rifle securely fixed, and every attention observed in loading &c., will throw the whole of a round of twenty shots within a circle of fifteen inches diameter at 300 yard. The best two-grooved rifle we ever tried will not do this, and morever, require some feet more elevation, at the same distance. At 300 yards, the two-grooved ball requires a perpendicular height of six feet more to strike the same object, with the same weight of powder, and the same weight of ball. At 500 yards, the exact weight of charge, and the same degree of elevation, gives the spherical ball a range fifty yards further. At 600 yards, with four drams of powder, the spherical ball invariably ranges, with the same elevation, full sixty-five yards further: 700 yards the range is most glaringly apparent, the difference being nearly 100 yards. At 800 yards the spherical ball, four drams of powder, and a perpendicular elevation of sixty feet, or thirty feet arc, reaches the object, the other falling invariably more than 100 yards short. These experiments were all tried with powder from one cannister made by Curtis and Harvey. The spirals of the grooves were the same, one turn in four feet.* If the difference is so great under these circumstances, what will it be where the spiral is a turn in two feet six inches? The difference will be

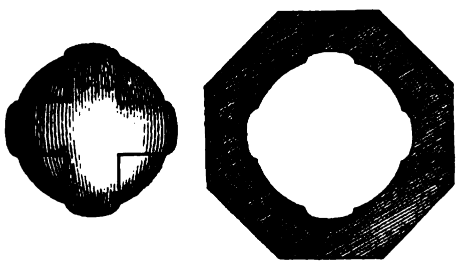
* Which accounts for the short range and large charges.

twenty per cent. greater. "But the judicious improvements it has received at the hands of Mr. Lovell have rendered it when skilfully used, a weapon of unerring aim, even at the prodigious distance of seven hundred yards." As we have before said, the doctor has taken this assertion on trust. We have been present at the practice at Woolwich, and never yet saw any thing approaching that distance, in fact, the best informed advocates of the plan admit it will not *range the distance.* Oh, but, they say, look at the accuracy. Greater, it may be, than the old *military*, but that it is superior to a well-made sporting rifle, we totally deny: it is as far inferior to these, as it is superior to the old one it has superceded. The utmost range of a rifle barrel of three feet long, twenty to the pound ball, with a charge of No. 2 grain sporting powder of five drams, at an elevation of eight degrees, is about 900 yards; a rifle on the two-grooved plan, under the same circumstances, rarely reaches 700 yards. This is a fact deduced from extensive experiments. We are quite satisfied that the spinning motion the ball receives from the twist of the grooves, is never retained above 250 yards, as all the balls above that distance strike the sand upon the half sphere, and leave, by so doing, an indelible mark, proving that the axis has changed from being a horizontal axis to a pendicular one; in short, any person studying the matter, and taking into consideration the great resistance the atmo-

spheric fluid opposes, will perceive such is the certain result, for a belt nearly equal to one-fourth the whole diameter, must create a *sawing* in the air to a great extent: the flight is attended with a whistle at all time short of 250 yards, after that it ceases.

The cause of the great charges of powder, required to obtain the above results, is created by the great additional friction of the spirals,—a fact clearly developed by the experiments, with our improved musket, which ranged with four drams of powder 1385 yards, yet with five drams it is a difficulty to obtain a range of 900 with the ordinary constructed rifle barrel. A fact of such importance, as to be a question if rifles are fitted for military purposes at all.

Another abortion, "Rifles with four grooves and two bands round the ball at right angles, (as below,)

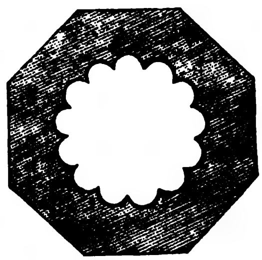


to each other, have been proposed and tried by Dr. Mitford, with good effect." All the arguments advanced against the other, apply to this, with one

exception, the distance between the projections not being so great, the action of the resisting fluid will be less. An immense number of plans, containing all the *marrow* of these, have been tried many years ago, and discarded, from the very fact, that the spiral motion can only be retained on smooth bodies for a considerable distance, and experiment would convince any of those *inventors* that it is contrary to the established laws in science. We can fire 100 balls on the ground selected for experimenting, and recover all the balls, and by these means, arrive at excellent, incontrovertible conclusions, and we find that this extreme spinning is invaribly exhausted at or near 300 yards ; the round ball retains it near one hundred yards further, showing the effect of obstructions, and also that all balls change their axes, the round ball having it at right angles, though horizontally to its direction. What was stated in " The Gun," in regard to the twist of the spirals, experience has fully taught to be correct› and we shall therefore quote a few pages.

The point, however, which we shall endeavour to elucidate, is the correct degree of spiral which barrels of different lengths require. We have repeatedly tried barrels with spirals varying from one turn in 4½ feet, down to a turn in 2½ feet ; and the conclusion arrived at is, that a barrel 3 feet long should have three quarters turn in its own length, being one turn in four feet ; a barrel 2 feet 6 inches,

as much in proportion as a turn in 3 feet 6 inches; a barrel 2 feet and under, a full turn in the space of from 3 feet to 2 feet 6 inches, according as they vary in extremes; a short barrel requiring much more twist than a long one. The form of groove should be a half round, and the number according to the size of the bore; but they should be so close as to make the projection approach to an edge or



surface, varying from an eighth to a sixteenth, or less of an inch, which will of course vary with the number and the breadth of the grooves. A barrel carrying a ball, eighteen to the pound, should have either eleven or thirteen grooves. The Germans have their rifles with as much as one turn in three feet, and even more; but their barrels are generally short. The Americans have quite as much twist; but their barrels are very long. As either the German or the American rifle must be constructed on a wrong principle, we shall endeavour to discover which.

"It is an ascertained fact, with respect to gun-

powder, that a certain quantity burns in a certain space. This being the fact, it follows, that the short rifle cannot project a ball beyond a certain distance, as within a barrel of that length, more than a certain degree of power cannot be generated. The velocity, too, of the ball being determined by the degree of force, it cannot obtain above a certain speed. This speed progressively increases as it travels from the breech to the muzzle. If it follow the spiral of the grooves, and revolve with them until it leaves the muzzle, it will continue to revolve to a certain distance. It must, therefore, be clear from this establishment of facts, that a long rifle, charged according to its length, must, of course, generate more force, and give the ball a greater initial velocity, than would allow it to follow the grooves in a barrel with much spiral. For instance by the time the ball has travelled eighteen inches, it has acquired that degree of velocity with which the ball projected from the short rifle left the muzzle. Its speed and force still keep increasing as it travels the remaining length of the longer rifle; and that force and speed become so great, that it is liable to overtop the grooves, if the spiral is of the same degree as in the short one. We account for it thus; the speed of the projectile is increased every inch it travels in the barrel, after the first movement, if the force be proportionate. If the speed it has acquired by the time it has travelled the distance of

eighteen inches, be at the rate of 1000 feet in a second, it will have acquired twice that speed, when it has travelled the other eighteen inches. With a velocity so increased, it is not probable that it will follow the grooves, but that it will overtop them. To prevent this, a barrel should be very much twisted in the spiral at the breech, and that twist should keep decreasing towards the muzzle. We will suppose a barrel three feet long with a full turn in the spiral. For every hundred yards this barrel projects a ball, it causes it to revolve on its own centre 100 times. Thus, the outside of the sphere has travelled further than the centre, and has naturally that addition of atmospheric air to contend with. We would ask, if this ball can fly with the same velocity as a ball that revolves only fifty times? Assuredly it cannot.

"The ball will not pay that attention to the grooves, except the barrel is very short, and then the speed is less. This we ascertained, after repeated experiments with an American rifle and a German one, the former 34, the latter 32 balls to the pound. The American was three feet two inches long, the German twenty inches, and the turn of the spiral in each, in proportion, once in three feet. The first experiment was at a body of soft clay, at 100 yards distance. The charge of powder in each was alike. We found both the balls, and on examining the ends, found that the one furthest in, had been

projected from the barrel first, and the marks cut by the grooves on the edges of the ball quite perfect. We then increased the powder and fired again. On examining the balls, we found the long rifle had obliterated all the marks made by the grooves on the ball. It would go down the barrel without any pressure, and had the appearance of an oblong, occasioned no doubt by its coming straight out of the barrel, and not following the inclination of the grooves. The appearance of the ball thrown from the short rifle was the same as before. We then cast a length of lead in the long rifle barrel and cut it into pieces like balls, and loaded with the small charge of powder and one of these pieces of lead. We fired, got the piece of lead, and found the projections cast on it by the grooves in the barrel nearly as perfect as when put in. We then loaded again, with the increased charge of powder, and another of these pieces,—fired, and found, on searching for the ball, that it had gone in broadside. The projections were clean cut off.

All projections on balls we have found to be productive of evil. In no case is their action uniform: they may in some cases shoot very well, for instance when a charge that exactly suits them be used,—a charge that gives a velocity just enough to allow the ball to traverse the grooves. Since Mr. Lancaster's experiment, every shooter is obtaining moulds with projections on the balls to fit their

rifles. It is useless waste and cannot be found to answer. Immediately subsequent to the above trial, moulds were made in the arsenal at Woolwich, and balls with projections were tried in the two grooved rifles. Instead of an increase in the range they found a loss of nearly 200 yards. In fact projections never did nor never will answer except in certain cases and small charges. We have tried all shapes of balls, even approaching the shape of an arrow or the old bolt of the cross-bow, yet never found any shape which under all circumstances excels the plain spherical ball.

Additional momentum may be obtained in all rifles, simply by having a variety of moulds to cast balls of an oblong form, a sugar loaf or any other shape, the fancy of the user may dictate. Very large-bored rifles are not advantageous in proportion to their bulk, while any weight may be projected more economically from a smaller bore and with increased advantage (as barring friction) you gain on atmospheric resistance.

"We then tried these two rifles as to range, and found that, with the same charge, the range averaged within thirty yards of each other. The long rifle had the advantage. The situation being the same on which the former experiments were tried, the balls were easily obtained by tracing their grazes, until they were spent. With the small charge, the projections were perfect. On increasing

the charge, it was found that the short rifle did not increase her range above twenty yards, while the range of the other was increased nearly 120 yards; but then, as expected, the projections were cut quite off. These experiments, we trust, prove the correctness of our assertion, that in a given space only a certain degree of force can be generated, and that if the charge be small, or the velocity trifling the ball will follow the spiral of the grooves; but then, when the charge is proportioned to the greater length, too much spiral is an evil, by creating friction, and thus unnecessarily destroying the force and velocity, and neutralizing the effect intended to be given by the spiral movement

We then altered both to percussion, in order to ascertain the difference. On firing with the small charge, as before, we found the range some yards greater in both. On examining the balls, they both looked as if the projections had been partially cut. We have no doubt that this had been occasioned by the increased speed. We then added about one-half of the increased charge of powder before used; and, on firing, found that the ball from the long gun had its projections cut off, certainly, but not so close as before; while that from the small gun was without alteration. From this and other experiments, we concluded that for rifle guns, percussion is very much superior to flint, and is now for military purposes, in universal use. We have also come to the

conclusion that, in a percussion-rifle, the turn of the spiral should be less than in a flint one, on account of the increased velocity given to the ball."

It will be quite clear, that science is best consulted by using a plain spherical ball, with the grooves of the rifle sufficiently numerous, and not too deep. For any roughness on the exterior, influences the range of that ball considerably. The use of patches are inseparable from good shooting, both on the score of protecting the ball, and also cleansing the tube, softening the deposit by the grease, for strange, but quite true, that in firing with high velocities, the ball has a considerable portion cut by the friction on this deposit from the zone of the bullet; and pointing out clearly the immense loss of force, even this trifling accumulation creates. We have known in a shooting gallery, a rifle to be fired one hundred shots without washing, merely by using greased patches? fifty could not have been fired without. Then just imagine the state of a regiment of riflemen, in a long-continued engagement; it is all well enough in a practice-field, but actual warfare turns the tables.

Double rifles have nearly superseded single ones; for few who can afford the additional price will use the latter, when in the same weight he can have two useful weapons. The one great end generally sought in a rifle, is sufficient weight to neutralise the force of the explosion or recoil. The additional barrel

answers this as effectually as additional thickness of iron in the single, but there is one objection which we have never been able to master in the construction of double rifle barrels, and we much doubt the possibility of effectually overcoming it—another proof that mathematical proofs are frequently wrong in practice, however correct in theory. We have always held that it is essential, that double rifle barrels should be put together perfectly parallel. We followed this rule, and were at considerable cost in perfecting tools for the purpose, and strange to say, in trial we found invariably that the right barrel threw the ball slightly to the right, and the left to the left. This we have been at enormous trouble to ascertain, and positively enabled to declare it is an indisputable fact. The cause of it is evidently the recoil not striking the stock in the centre, but on one side, which causes the gun to swerve to that side. However small or unapparent the recoil may be, still there is a recoil, and hence is its effect. To remedy this it is necessary to incline the barrels in, towards the muzzle, to contract that tendency, but in doing this another evil is created, for you can only do this to suit a given distance either 100, 150, or 200 yards, as may be determined. Thus it will be perceived a deficiency must exist at all times, and it shows clearly the necessity for motion being resisted centrically, if truth is to be maintained. This defect in the double rifle will always be a drawback to the

most correct shooting, yet under ordinary circumstances it may not be a matter of vital importance, neither does there exist any means of sighting to overcome the difficulty. The only way to obtain a double rifle perfectly true, perfectly parallel, is to construct the barrels one above the other, as double pistols are now constructed. The only objection to them is the difficulty attending the arrangement of the locks, as one cock must strike the nipple, the thickness of the barrel below the other, and is an unsightly matter at best. These facts lead to another, namely the necessity of all rifles being stocked as straight as possible, avoiding in all cases any casting off in the butt, as it is evident these matters have considerable influence on the correctness of shooting.

Blaine, "on Shot," falls, as most others do, into a mistake. "The improvement in shot, by introducing quicksilver into its composition, was an important one. In rifle shooting it might be employed to great advantage on many occasions, particularly in attacks made on large animals, as elephants, and others of the '*Pachydermata, or thick-hided.*' Here the additional weight of the ball gained from the quicksilver assists the projectile force (momentum) greatly, while the increased hardness obtained from the mercury employed, would also assist the hunters in more readily penetrating the hides of many objects of foreign chase, which now escape, or can

only be *conquered* by an iron bullet, which must be large, and hence would require a gun of enlarged calibre, and unwieldly dimensions." Here is one of those *outre* ideas on projectile force which puzzles us to know where they had their origin. Mr. Blaine talks of specific gravity like a philosopher, but of hardness like a tyro. For in reality the harder the metal the less the result. The peculiar advantages of lead, as have already been shown, arise from its softness and incompressibility, for in projecting lead against the hardest substance known, which any projectile will penetrate, namely, iron, and examine the cause philosophically, you will find that in the act of striking the iron, the ball is partially flattened, and communicating to the iron it is in contact with a portion of its velocity, the piece is punched out of the plate before the larger mass receives any motion whatever, the velocity of the blow being greater than the velocity of the vibration or wave, which communicates the motion to the larger mass. The particles in compact with the lead are driven back upon those behind them, so quickly, that they lose cohesion by passing the limits of attraction, and are thus removed from their place in the mass. Iron would not do this, or, in fact, any other similarly hard body; because, both in them and the body struck, the action would be the same, for an elasticity existing in both, the rebound would be in proportion to their different

weights. For instance, an iron ball fired at an iron plate, the ball rebounds as far back as are their dissimilar weights, while lead, if not able to penetrate, falls to the ground, having communicated all its force to the object struck; therefore, the advice to shoot the "*Pachydermata*," or thick-hided animals, with iron balls, must be taken at the value it possesses, which is very small, as it is decidedly opposed to all science, and contrary to every experiment we have made. An additional impetus, by the aid of a little more powder of a suitable grain will give more penetrating powers to lead, than was ever possessed by any other metal, save the precious ones.

For the result of a leaden ball being flattened against the bones of large animals arises from a want of velocity entirely, and will never occur if that requisite is possessed by the projectile.

As an illustration of the advantage of not using too quick firing gunpowder, we shall quote Robins again. He says, "For this matter, I have experienced in a small rifle-barrel piece, carrying a leaden ball of near half an ounce weight. This piece, charged with one drachm of powder, ranged 550 yards, at an angle of 12°, with sufficient regularity." He is not speaking of powder, but the deflection of the ball, yet the range, the matter we quote for, is nearly 150 yards further than the same quantity of our fine-grained powder will pro-

ject the same weight of ball under the same circumstances, for we find 400 yards quite as far as a very good barrel will throw the same weight. Now it will not be for a moment attempted to be said his powder was anything like what ours is; but, in short, the ranges he states as having obtained, are considerably greater than we can with our best sporting powder obtain.

Military rifles should never be shorter than three feet,—say three feet three inches, with ¼ turn of spiral,—the length of the musket. They should not be larger in the bore than a ball eighteen to the pound, as at that length a force, calculated to throw an extreme distance, might be generated. Whatever may be the arguments for heavy substances, they do not avail here, as it is impossible to throw them either with velocity or accuracy; for there never can be certainty, where so much elevation is required. The size of ball we have mentioned, can be thrown with great certainty, as far, if not farther, than any soldier in her Majesty's service can accurately survey a single object. For the purpose of annoying a dense body of men, such as a square column, such a rifle would be an invaluable gun; as the muskets now made will not throw a ball one-half the distance. As to the actual range of a rifle of this bore and length, we should think it would reach, effectively, the distance of 1500 yards at an elevation; as however, a ball in its flight

describes a parabolic curve, so great an advantage cannot be obtained by the elevation of the rifle, as of a smooth bored gun. For mark-shooting, at short distances, with small charges, they of necessity require elevation, as accuracy and not force is then the object; and as the ball flies slowly, elevation to a certain degree is indispensable to obtain accuracy.

"As many opinions exist as to the exact distance for what is termed *point blank* (and this the gunmaker may arrange, either by increase of powder, or by altering the elevation) it may be expedient to come to some determination. Before it is sighted a rifle should be tried, and the quantity of powder it will burn ascertained: then, to whatever distance she will project a ball in a parallel line with the earth, (if a plain,) is the *point blank* distance. The distance the ball droops in the next fifty yards should be ascertained, and a corresponding elevation added to the breech. As the best mode of sighting a rifle is by the leaf sight, the lowest sight should be made at this elevation. The next fifty yards must also be obtained in the same manner; and so on, till you obtain the extreme distance to which the ball is sent.

"The English military rifles are much too short, both for obtaining great range of distance, and for accuracy of aim. Force cannot be obtained without length. We cannot see, if our rifles were made with

the barrels a little tapered, that it would be at all objectionable; as it would allow of a greater length without any additional weight, and by judicious management, they might always be less than those of the musket.

"The principal objection urged against the adoption of the rifle, is that of loading. We know not how quickly it is possible to load a musket; but with cartridges properly made, we think we could load and fire a rifle four times in a minute. But then it will be said, at the conclusion of so many shots, the rifle gets so foul, that it will be difficult to get the ball down. Not difficult at all. Have your cartridges made with a saturated cover, to fit properly the grooves of the rifle, to surround the ball.

"It would clean the barrel so much, as to allow forty shots to be fired with as much ease as you now fire twenty. Or let a steel-wire brush be attached to the rifle; and by screwing it to the end of the rod, you can, by two or three times rubbing up and down, remove any accumulation of dirt from the powder. If, however, the covering we have mentioned were used with a weighty rod to the rifle, there would be no occasion for cleaning short of fifty shots."

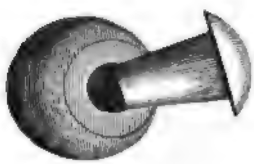
The idea of a body of riflemen armed with this peculiarly constructed gun, (two grooved rifle,) is absurd, and shows how matters are conducted in

first-rate states; the name may inspire terror, but we have been acquainted with rifle corps, the individuals of which know as much about the use of a rifle as a "theodolite." Ask them a question at what range they can shoot. "Oh," will say a knowing old sergeant, "a musket will 'kill a mile,' but our rifles exceed that considerably. We practice from 500 to 1000 yards," and all such twaddle as this. Arms are put in men's hands and that is all, as for any instruction it is quite out of the question, learn what you can, and God speed you; neither officers nor men are ever taught to use their rifles. We have seen companies at ball practice, where the officer says, "What the devil are you about, *Sergeant Target*, you have been near half an hour longer in firing than No. 8 Company was: be quick, sir!" What a folly to give arms at all, without instruction! but how much greater to give rifles and no practice at sufficient ranges. A well-*constructed* musket is perfectly capable of projecting balls, too, with truth.

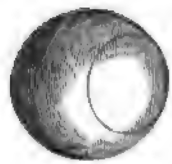
We have no hesitation in asserting, a corps of men, of moderate abilities, could be instructed to shoot, with great accuracy, at 500 yards (*not* 700) * but at even greater, to be the means of considerable loss to an enemy. The range of a six-pounder brings the users within the bounds of danger with a good rifle, as from 500 to 700 yards is generally the average distance they fire from.

* But the French infantry practice at 1000 yards.

Five years ago we perfected and laid before the board of ordnance, a new plan or system of constructing expansive balls, which is accomplished by having two dissimilar portions. An oval ball with a flat end and a perforation extending nearly through, is cast, a taper plug with a head like a round topped button is also cast, of a composition of lead, tin, and zinc as below.



EXPANSIVE BALL BEFORE USING.



EXPANSIVE BALL WITH PLUG DRIVEN HOME.

The end of the plug being slightly inserted into the perforation, the ball is put into the rifle or musket with either end foremost. When the explosion takes place, the plug is driven home into the lead, expanding the outer surface, and thus either filling the grooves of the rifle, or destroying the windage of the musket, as the case may be. The result of this experiment was beyond calculation, and for musketry, where the stupid regulations of the service require $3\frac{1}{2}$ sizes of ball difference for windage, it is most excellent as remedying this considerable drawback upon the usefulness of the arm. As the facility of loading is as great, if not greater, than by the present. As regards its application to rifles,

there can be no question of its advantage, if there exist any requirement for a ball to be acted upon by the grooves at all, which we do not think is advantageous, in fact, there exists no question. On the large scale its extension admits of an unlimited bound. How powerfully tremendous would be the effect in one of Monk's 56lb. guns; no need of Mr. Warner's exterminator.

A round of experiments took place, consisting of about 120 shots, fired by a party of the 60th Rifles, commanded by a major of the artillery. The result was most satisfactory as compared with the same number of rounds on the old plan. A man was able to load three times, while by the old system he loaded once; and the accuracy of range, at 350 yards, was as one to three. A considerable anxiety seemed to have taken possession of the officer in question, and not heeding the concealment of the matter, we explained the plan, and the consequence was, that the *excellent shooting, the rapidity of loading,* was all at once lost sight of—the talisman was broken. The only further notice we ever received from the Board was, "it being a compound," rendered it objectionable. The mind runs riot while writing the fact, and astonishment gives place to contempt, to think a matter like this should be treated with such cold disrespect. But the parties who are really disinterested do not see what is contained in this casket, and those that do, are interested in

laying *the plan* on the *shelf* for a convenient season. Thus it is, and ever will be, in England. A plan in advance of the age is treated as chimerical—as the emanation of a scheming brain, and, as such, untenable. From causes like these, England's talented officers and brave men are invariably the worst equipped, and the least taught. What is of the most consequence, is treated as of the least importance. Correctness in shooting with a rifle, is dependant upon various circumstances and none of more moment than the shooter having confidence in himself.

One great drawback to correct shooting, is produced from the stock being thrown off at the butt end: in other cases from imperfections in the stocking of the gun,—all truth depending on the barrel or barrels being both stocked and held perfectly level in the act of using. It must be quite clear, that in case the right barrel of a pair, be depressed but the 32nd part of an inch, the angle of the sight on the top, instead of giving elevation, will cause the line of flight of ball to be to the left and "vice versâ." Therefore, first of all be sure the gun is held square, and great advantage will be found in pointing the muzzle in all cases a few feet below the object, and rising it in a perfect line upwards to the bull's eye. If this can be done well in addition to the gun being held square, the better half of the difficulty is overcome; further practice will make perfect. The point next in importance, is to

take off the weight of pull in the trigger, during the upward motion, overcoming the last atom of weight as the muzzle sight covers the bull's eye. It must be done so gradually, that no jerk or pull can move the gun, be it ever so triflingly; in fact all good shots fire thus while the gun is in motion. If the sight cannot be correctly obtained during the movement, always take the rifle down from the shoulder, and raise it again,—for depend upon it, rifle shooting can never be acquired perfectly, where the habit is practised of holding the gun at the shoulder, "poking" the muzzle about and seeking the bull's eye. All good shooting is produced from the shoulder,—an absence of pulsation in the body which is induced by holding a weight,—the shoulder-rests are found to be the cause of vibration; resting one part of the body and straining another begets it instantly, and where rests are used, they should be merely supports for the muzzle, and not for the centre of the gun. If the centre is placed upon it, the action of recoil is almost sure to jump the gun upwards. The best shooting can be accomplished from the shoulder if the above instructions be carefully followed. Avoid in all cases gripping a rifle tightly, or you will most assuredly communicate the pulsation of the body to the rifle.

The French government are making great efforts to improve their military system, in imparting to every soldier as much information relative to his wea-

pons and the best method of using them, as is compatible with his limited education. Their institution of a normal-school, for the instruction of the whole army in all that relates to guns, shooting, and natural "trigonometry," is proof of this. A detachment from every infantry regiment in the service, arrives at "Vincennes" early in the spring, and undergo a complete course of instruction during the whole of the summer and autumn months, or until by ability they acquire all that is to be taught. The first and a very essential part of the duty, is to teach them to judge of distance, and for this purpose a soldier takes a target and runs straight ahead as far as he pleases. Having planted it, each man is called upon to judge the distance, which is recorded in a report of the day. This exercise is carried on to a great extent, until each becomes well able to judge correctly, and then commences the instruction on shooting, each soldier using an elevation according to the distance he calculates he is from the target, and this is practised at all distances from 500 to 1000 paces. The greatest degree of perfection attained by the instructed, is rewarded by promotion or otherwise, and such skill in shooting is displayed by these various detachments, as would truly astonish our military officers. Having witnessed it, we candidly admit we did not think such correct shooting attainable by so large a number of individuals, and is proof of what may easily be accomplished if earnestly persevered in. At the fall of the year,

these men, or such of them as are proficients, are despatched to their various regiments, where they become instructors in their turn ; so that in a very few years, it may be safely calculated, the French army will be the best shots in Europe, if they are not so at this period. The French musket is considerably lighter than the English, also considerably less in the bore, being 19, and only one line being allowed for windage. Their cartridges are also made up in a superior way to ours. The length of barrel is 3 feet 7 inches ; bayonet 18¼ inches, making as a pike a total length of 6 feet 5 inches—longer by some inches than the English. By various judicious alterations, they have reduced the weight to a trifle under 10lbs., bayonet included. The barrels of all their arms seem to be the best constructed parts of the gun. The *hole* very straight and well bored. The lock adopted is backwork swivel action in the musket, and a bar swivel action in the rifle, very short contracted actions apparently, not at all calculated for much hardship or long service. In truth they want much improvement in both mechanical action and mechanical work. This we wonder at, as next to a good barrel it is essential to have a good lock. The stocking is sound, but the finish of stock is very clumsy and unsightly, and the fastening of the barrel to the stock by bands and hoops of iron adds much to the want of appearance. But this is by far the most suitable method when we consider how much firmer the barrel and stock

are held together, and how effectually the stock is prevented from being splintered or injured in the hands of a raw recruit. However clumsy therefore it may be, we must admit, for durability and strength, it far excels our method of using bolts or pins; it also enables a man to take the barrel from the stock to clean or for other purposes without the aid of a quantity of tools. The stock behind the lock is very short and very straight, suiting no doubt the small race of men composing the French infantry, and the straightness of the stock tending to make them keep the muzzle up in firing."

But one especial point to be noticed in the French musket, is the absence of weight in the forepart. Our musket is peculiarly heavy forward both in "wood, iron, and brass," and nothing in the construction of military arms requires greater attention. The range and accuracy of the French arms are worthy of being admired. We witnessed them range 1400 yards with a charge of four drams of powder. The windage allowed is trifling, and even this is lessened by a wooden cup being fastened to the ball in the cartridge, which the soldier reverses after pouring the powder into the barrel. It is thus intervening between the powder and ball, and is expanded by the explosion in a way to effectually fill up any windage, and cleanse away deposits at the same time. It is on Joe Manton's principle as applied to cannon. One great advantage attending it is, that

it prevents a rolling motion being given to the ball during its passage up the barrel, and any tendency to a zig-zag movement; for it is clear if a ball be loose in the bore, it will acquire a rolling motion at right angles to its line of flight, and thus aid the gravity the moment it quits the muzzle. The shooting we have already noticed, and having been favoured with access to the statistical records, we found the average of their performances to be, at 200 yards 56 per cent.,300, 30 per cent., and at 600 yards 10 per cent. They have them correctly sighted up to 600 yards, after that, the arrangement is left to the judgment of the soldier. These are great results, and we should like to see them equalled in this country. Great numbers of experiments have been conducted with an invention of Monsieur Desvigne's. It is a carbine, or light musket, which loads at the breech, by a simple plan of withdrawing the breech by a parallel motion worked by a lever, on precisely the same plan invented by Tonks in America. The nicety required in the fitting of this cylinder into the barrel and the very slight matter which puts all these contrivances out of "gear" acts against, and in short is the stumbling block to the adoption of even, the very smiplest. No moveable joint we ever saw, will long withstand the action of the intensely heated fluid of gunpowder during repeated explosions. The excellent shooting of this carbine even up to 1000 yards has shown the French govern-

ment the advantage that may be accomplished in gunnery, for the only improvement in the Desvigne carbine is that of loading at the breech, for you load with a ball having no windage. For there is no better method of ignition or other improvement, but as we have already remarked, no gun loading at the breech, can be serviceable for any length of time. The objections to all these plans are so great as to justify us in saying they never can be adopted by any prudent government.

The French rifle is a very powerful gun, weighing about 11 lbs without the sword. The bore is 10, and the ball bordering on 1½ oz. weight. The grooves in the barrel are 6, cut very shallow and having a spiral one turn in 6 yards, having thus a length of barrel about one-sixth of a turn. They shoot very splendidly with them up to 1000 yards, extreme range 1500 yards. The performances with them average at 600 yards 54 per cent., at 1000 yards 30 per cent, charge 4½ drams of powder. Here is another proof what the absence of friction will do in gunnery—a clear developement that velocity is "every thing," both accuracy and range combined. Though the French have adopted one turn in 6 yards, yet all their experiments show that one turn in 5 yards is the best under all circumstances. The Belgians too find the same result to a fraction. The very extensive experiments the French government have instituted entitle them to an established claim for knowledge

in the science of projectiles. They have lately commenced the construction of double muskets or carbines, for some light infantry regiments. The workmanship of the French musket will be improved, as very great exertions are being made to improve their workmen. The cost including bayonet and all is 34 francs; a much lower rate than our produce costs the nation. The principal gun manufactories are at Chatterhault and St. Etienne, and most of their boring-grinding is done by water power. The nipple is placed on nearly the top of the barrel, and thus is a direct communication obtained to the charge. It is good, but not sightly, as the cock to the nipple is made so extremely long, and lays over so much, as to resemble a man over-reaching himself, but all their plans combine utility and safety, with a total absence of any straining after mere appearance.

The Belgians make much better arms than the French, mechanically; but all their principles are those of the latter with this exception, that their musket-barrel is one inch shorter. The charge, bore, and weight, assimilate as near as possible. The same fastening of the stock and barrel by bands, securing the bayonet by a loose hoop bolting the whole. But their working artisans are men of more ability. The Belgians' musket lock is superior in principle to ours, and the work equally as good. They have adopted the swivel-lock, in fact

its advantages are seen by every nation except ours. The limited revenue of a small state like Belgium will not permit much being expended in experiments, yet they conducted one at Antwerp in 1844 extending to nearly 50,000 rounds, with every description of arms they could obtain, including our musket and rifle. The shooting practised during this experiment partook of the French practice at "Vincennes," trying at all distances and all elevations, and drawing their conclusions from the grand total. An officer, who was present, remarked to us, "your two-grooved rifle is the worst we tried—I think the Emperor of Russia has made a mistake in having 15,000 made on the same plan." The Belgian rifle is 3 feet long, 18 bore, with a spiral 1 turn in 5 yards, they will range 1200 yards with $3\frac{1}{2}$ drams of powder. The government have lately instituted a small but compact manufactory, for the construction of their military arms, where the barrels are welded, and every stage completed within the walls. Their arrangements in machinery for various parts and purposes about the construction of the gun are admirable. Much that is done in this country by the hand, is there done by machinery. The barrels are squared, and the part where the nipple is inserted, all shaped and fashioned by aid of the engine. The rifling of their barrels is also done by steam, and is an invention of extreme simplicity. The workmen are drafted

from the ranks of the army, taught a branch of the trade, and by their engagements as military men become a description of workmen, divested of that discontented nature so frequently met with in the gun trade; and at the same time enabling the government to secure those services at a moderate expense. The perfection of the machinery, and the great division of labour, leave but little for an active mind to master, for a young man may be soon taught one operation; but if two or more are attempted to be added, he fails in all,—and in this light the Belgian government views the matter,—for one defection is of no importance where the operation is sufficiently simple to be easily learnt. We will instance the lockfiling by the "Liege" government. This is effected by five or six different men, at different branches; one files the lock-plates to a model, another drills and taps the holes by the aid of a metallic "*templet*," another files tumblers, another springs, and so on; and at last others combine all these productions in one. The result of this is a continual succession of fresh workmen. Mr. Lovel, in a visit he paid to "Liege," endeavoured to persuade them to adopt one of what he calls his improvements. The Belgian musket-lock is back-action, with a long active main-spring, certainly longer than we are accustomed to see; but from that fact more calculated to endure. This however Mr. Lovel "discovered was

an evil—far too long by one half." Now any mechanic, who will be at the trouble to examine the latest improved locks on the English muskets, will find a main-spring required to draw 25 lbs., not more than 2½ inches in length, the most contracted unmechanical spring ever made. It would be quite as wise if an archer were to cut a third from the length of his bow, and expect to find in it the same elasticity. But, however, he here had parties to argue with who certainly are well acquainted with the principles of mechanics. The Belgian stock is neater finished than the French, but durability is more valuable than mere appearance. Better finished work is got up by the gun trade in "Liege," than is displayed in the government work, but at a higher price. The Belgian musket is calculated to cost thirty-two francs. They, like the French, have a very ugly cock or striker, but this is caused by the insertion of the nipple on the top of the barrel,—and as it requires the cock to lay over the stretch, it is awkward in appearance. The manufacture of arms in "Liege" resembles the practice of Birmingham very much. There are no manufactories; all work is done by piece, or by workmen who employ an assistant or two with a number of apprentices; but one thing is peculiar, the different branches are located in different quarters. One parish containing stockers, another barrel-filers, another lock filers,—and so on,—and all

crowded together in a few streets. Barrels are welded, bored, and ground, in villages at a distance from "Liege;" and the different districts are celebrated for particular parts. "La Chaufontaine" is the particular part where the best and finest Damascus is produced, and other localities produce muskets, and others rifle barrels. They have not yet attempted to produce the welding of musket, or other plain barrels, by the aid of the rolling mill, as is done in this country to an enormous extent.

The Belgian workmen are an obstinate race; no change is permitted from what they have been accustomed to for ages. Some barrel-welders, a few years ago, emigrated from Birmingham to Liege, and no doubt they could make a greater quantity of barrels in a given time, than they had been accustomed to see, yet we believe they made the district too hot for the "Brummagems," for they soon returned and reported rather unfavourably of the way in which they had been received. Most of the German states seem to draw their supply of arms from "Liege." You can there see specimens of all; when we recollect that all their barrels, and the parts attached to them, are hard-soldered with brass, it will be apparent they must be very perfect in this branch. They certainly do it in a masterly style. Their brazing (unlike ours, which is generally by spelter or grained brass) is effected by sheet brass, very thin; they cut

it into slips and insert it between the two parts to be attached together, heat the iron until the brass melts, then press the parts close until the brass sets. In brazing a pair of double barrels together, the whole is perfected without drawing the barrels entirely from the fire, until all is melted. In fact, if they are not a hard working class, they are unquestionably very skilful in expedients. Many ingenious plans of loading at the breech are to be seen in every gunmaker's shop in "Liege." They seem to possess a "talent" for this sort of thing; but as we have already remarked, save as proof of skill, such plans are practically of no use. The adoption of a double musket is the next improvement of consequence which will be introduced into the French army. They have made a number which are now in use experimentally, and if found to answer practically, will be adopted in several rifle and light infantry regiments. The bore and trifling windage of the French and other continental states, being so much smaller than the English, will facilitate this arrangement, as a very useful double musket could be made not to exceed 10lb. in weight, and unquestionably, it would be a great advantage to the soldier.

The Austrian musket is the same bore as the Belgian and French, but only the length of the former 3 feet 6 inches, and weighs, bayonet included, within a trifle of 10lbs. Their outward finish is considerably better than either of the two, and may be pro-

nounced along with the Prussian arms, the best finished of any on the continent, they too, have adopted the swivel-lock. The nipple is not inserted so far on the barrel as either of the two former, and this has a much more sightly appearance. They have also introduced the French cartridge, with a wooden cup attached to the ball, and they shoot well and up to the range of 1400 yards They too, have a school, and a system of encouragement to perfect their soldiers in the accomplishment of good shooting. The Austrian carbine, or rifle, is of the old school, very short, being only 2 feet 4 inches in the barrel, and having a $\frac{3}{4}$ turn in that length, bore 20 to the lb. The range is not, nor can it be expected to be, more than 600 yards, and from the excess of friction, requires a great elevation to range that distance. It has been found in several grand trials of the rifle-corps, against an equal number of "the line," that the musket excels in all cases above a certain distance, and on the whole, was awarded the first place. The arms were in some cases transferred, and still the musket was found the most advantageous under all circumstances. This result might be fully anticipated, as the construction of the rifle is not calculated to ensure range. Better accounts might have been anticipated, when we recollect the men who compose many of their light troops are recruited from the "Tyrol," a district so long celebrated for intrepid and skilful marksmen.

There appears to be a disposition on the part of the Austrian government, to improve; and we may calculate on a few years effecting with them great changes, for when a government institutes experiments, you may calculate they are contemplating change. There is a regulation in the Austrian army worthy of consideration in this country; they divide the men into two classes. The first class cannot be flogged, the second can, and is under the orders, or at the command of the upper class.

The Prussian musket-barrel is 3 feet 4 inches, bore 18, windage 7 parts of a hundred. The full length, bayonet included, is 6 feet 2 inches, weight 10 lbs 14 oz. They have not yet adopted the swivel-lock, but the workmanship on the whole is very good; they use a sort of holder to retain the cap on the nipple, resembling in principle the hammer and hammer-spring of the old flint lock; an useless appendage, as a well fitted cap is not likely to require any adjunct to hold it in its place. The range they say is about 1000 yards, but they never practice more than 300. A great quantity of their arms have been long in use, and the majority are still flint, in fact, France, Belgium, and Austria also, have a large quantity of troops armed with old flint muskets. None of these nations have a fixed period for arms being in service, but they are expected to hold together as long as possible; while in England, 12 years service condemns them, and in

reality, we should be astonished, considering the destructive principles in the locks, if they last that period. The Prussian rifle or carbine is 2 feet 2 inches long, diameter of ball 0·56 of an inch, ball without patch 0.54 of an inch ; the degree of spiral 1 turn in 3 feet, sword and rifle combined weight 9½ lbs. This rifle is the most tastefully finished of the whole continent—neat and compact in every part. But as will be perceived, the shooting qualities are very meagre, it cannot be expected to range in the extreme, more than 600 yards ; may shoot with small charges, up to 250 yards, pretty accurate ; but most assuredly the whole does not partake of any of the science of the present day, and here is room for very great improvement, and which we suppose will take place before they become competitors in a continental war.

The Russian arms are at this moment undergoing a great change. The enlarged mind of the emperor seems fully to comprehend the great advantage of perfect arms, and the result is that immense manufactories have been built, where large quantities are produced yearly, principally by natives, assisted by some talented workmen taken from " Liege " several years ago. Large contracts have at various periods been executed by the Belgians, and the same pattern in every respect has been followed, so that any observations applied to one are applicable to the other. The native workmen in Russia improve

very fast in all mechanical pursuits, great spirit being infused into this branch by the interest taken in the subject by the wary "Nicholas." The first will eventually enable them to produce arms inferior to none, for no matter of a pecuniary nature stops progress, no individual interest mars improvement, perfection so far as it can be attained, is the leading desire of the "Autocrat of all the Russias." But the late experiments in having rifles made after the pattern and principle of the English military rifle, must have proved itself long ere this to have been a total "*mistake.*" The intention of the order was understood to be the possession of a superior arm to be employed in the "Circassian" war,—then, what must have been the feelings of disappointment and "chagrin," to find the far boasted two-grooved rifle to be so far inferior to the common musket of "the line." That it has been found in practice so to be, we feel confident. It may have one good effect; it may convince the Russian government that it is extreme folly to adopt any "vaunted" plan or improvement in gunnery, without first *proving* the truth by experiment. The vast number of plans miscalled "improvements" in gunnery, are generally supposed to find sure patronage in "St. Petersburgh." It is a creditable and highly laudable principle in any government to encourage talent and invention, but it also requires a perfect knowledge in the "inventor" of every plan that has hitherto preceded,—

for nine out of every ten so called "inventions," are but alterations of principles worked to their failure in bygone ages. "Liege" is full of these things; hundreds of plans, upon which thousands of pounds have been expended, (all useless) and all rejected from complication less or more.

These remarks bring us to the question relative to the "Baron Huertloupe" musket, which it has repeatedly been announced has been adopted by the Russian government. Our belief is the contrary, knowing and feeling certain that the mere alteration in the manipulation of this musket could never secure for it extensive adoption; as improvements clear and demonstrable are required before any nation could be justified in changing the whole rule of operation, and without some very great and ostensible benefit were certain of accruing, which we cannot believe "exists," in the mere change of lock, striking upwards instead of the reverse, as at present, for all the other points claimed in this arm are of no public utility.

The American arms consist of three different descriptions; musket, rifle, and carbine. The musket is an offshoot from the manufacture of "Liege," from whence the Americans obtained a portion of their means of carrying through their war of independence. Since that period the same proportions have been retained, and the bore length and weight (which is 10½ lbs.), resemble the arms of

the continent in almost every respect,—if we except the fact that their improvements in ready methods of manufacture, employing machinery, to a great extent has naturally altered the outward shape of the stock, which is nearly all completed by the aid of the latter. The specimen we have seen is very soundly put together, and calculated to do a great deal of work. The Americans differ in their "*notions*" of warfare from most of the European nations. They are addicted to bush fighting, and neither with the musket or the rifle do they estimate range as of any importance. The wooded nature of their country may in a great measure be the cause of this. But it is a fact, that no experiments with small arms have been made by them at greater distances than 300 yards, and they declare they think such a range as far too great to be advantageous. But as respects their artillery, they seem very anxious for an "unlimited range," and we read accounts of "*monster-guns.*" "They will in the end pay for their whistle," as no body of individuals sufficiently versed in mechanical knowledge, and attentive observers of the progress of experiment, but must clearly see these things are in reality "monsters," which can only be useful as "bugbears," for most clearly none yet constructed on the extreme "*draft*" have come anything near the expectations formed by their projectors. Now a clear perception of the law of motion will show that "ve-

locity" or "range" (for they are synonymous) never can be obtained without the weight of gun is increased in a geometrical progression, with an increase of a few pounds in the weight of the projectile. This is a point not one in ten thousand gives the slightest attention to. The waste of money in constructing wrought iron "monster cannon" is proof how little the subject is understood in America. The difficulty in condensing large masses of wrought iron to make it ever equal in strength to cast iron, is never thought of, but yet it is a glaring truth. There is but one practical method of welding a cannon sound, and to do this it is necessary to form an indefinite number of pieces of iron, say fifteen, into segments of a circle, and with these forming a perfect circle as in building an arch; these when in a welding state must be driven in upon each other on the principle of each being a wedge; if the heating be perfect, the mass will be welded solid, but the difficulty of effecting this with ten or twelve tons of iron must be very apparent. However, small cannon have been so made,—and large shafts, even railway axles, with very good results, but large masses can never be condensed, be the power what it may, for heated iron is very much like in result to atmospheric air, nearly all force applied is neutralised or expended by a lateral action; and a fact very seldom noticed, if it has been noticed at all is this, that large masses of wrought iron form "crystals" of a much larger

size than is formed by any other metal whatever. They are at least ten times the size of crystal that the same weight of cast iron would take from its state of fusion.

From the sounding name of "American Rifle," the reader will expect to partake of a rich treat in the description of the various peculiarities attached to them, but we regret that the treat cannot be realised. The American rifle is only great in fame. There is no science displayed in the construction, which is not to be met with in every part of Europe, they have every degree of spiral that has ever been recommended, every variety of groove, and every size of bore—from 16 to the lb. to 140 to the lb.—every variety of length, and every weight. In truth the celebrity they have obtained is not for any perfection in their arms, for a vast majority of those they have are the commonest "Brummagem rubbish," made with no attention to science, but only for profit. No, the truth is, the Americans use the rifle more, probably, than any nation in the world. They are more expert generally in their shooting practice, and this has done every thing for them, and not the merit of their rifles.

We have seen American rifle-barrels, which were far from the straight, and far from being correctly rifled, yet they shot well. Why? because the bore is very small, the barrel burning powder sufficient to give a high velocity up to 100 yards, and as we have already remarked, accuracy at short distances

is the American rule of perfection. Occasionally the back-woodsman may venture a long range, but in a vast majority of cases the balls used are so small as to be perfectly useless at greater distances than 150 yards. To write a long article on the American rifles would be but a repetition of previous matter, as they have no established rule or principle, save in their military arms, and here uniformity is necessary, and the display of scientific principles in these is not very apparent. The military rifle is 2 feet 9 inches long, carries a ball 30 to the pound. The rifling is different from any used in Europe. The grooves are 14 in number, with 7 projections more prominent than the others,—an arrangement very objectionable, as it is clear these " projections " must either grip the ball so to indent it, or to allow the extra cuts to be of no use ; or if not gripping it, why have so many " furrows and lands ?"—two sizes remind us of cutting a file with half the teeth higher than the other half. The rifle, as a whole, is a handy weapon, but with the " old plan " of a " hook main spring " and " tumbler," it is what we may designate as a very nice " tool " for a gentleman's amusement, certainly not a military weapon as it ought to be. It is very near akin to the Prussian rifle, will shoot well at 200 yards, but no further. A number of scheming alterations have been introduced into the American service, and have met with countenance. " Six barrel revolvers,"

"six breeches revolving," and an endless list of this plan and the other plan of loading at the breech. But a very ingenious carbine made by W. Jenks, Springfield, Massachusets, seems to have engaged the most attention, as many as 14,813 rounds having been fired from one gun; they thus describe the invention.—"The improvement consists of a piston or plunger fitting in a chamber in the breech of the piece, which is drawn back by a lever and several pieces of metal, so as to permit the ball and charge of powder to be put into the chamber through an opening in the upper part of the breech. After which, the lever being depressed, the piston is forced forward by the above mentioned pieces of metal which constitute, by their position, a species of toggle joint. When the charge has thus been forced home, the joints are little beyond a straight line from the breech to the extreme point of action, it follows as a necessary consequence that the piston cannot be forced back by the discharge of the piece, and requires no fastening of any kind." This is the invention named as being on the principle of the "Desvigne" carbine. The facility of loading at the breech is easily got, but a vast number of objections tell against this one advantage,—admitting that in practice they have fired an immense number of rounds,—yet the very suspicious fact is allowed to escape, "that a drop of water was applied to the piston every ten shots." Of course it would not

work without, be it ever so well fitted. All these plans fail from the necessity of something to keep the joints of the machinery " lucubrated," the heat and penetrating property of exploded gases will find access and leave a deposit in the best regulated joints, and however well committees may report upon such plans, nothing in a report however flattering will convey to the generality of well regulated minds the conviction that simplicity in all cases is so far preferable to complication, that it is better to sacrifice a little trouble or inconvenience so that the mind may be content. " Jenks " differs from " Desvigne " in a most essential point, the latter has got a range of 1000 yards with his, while the former is content with 300, especially " if the ball only buries itself in the oak plank." Such a trifling result shows that the Americans care less about the perfection of their military arms than any nation we have yet named ; and that this opinion is not hastily formed, is proved by the fact that a board of four officers from the artillery and ordnance, reported and recommended the adoption by the American forces of this carbine, and the inventor states he has orders for 3,700 yearly for ten years. We repeat that this report shews that less is known in America on small-arm projectiles than in any part of Europe. With such a weapon " Jonathan " would stand but little chance of " beating the Britishers, "—that is a fact we " calculate."

The following is extracted from the description of American improvements by a late visitor.

"It must be interesting, where the manufacture of FIRE ARMS is carried on to such an extent, to know that our transatlantic brethren have perfected machinery for this purpose, of the most admirable description. We regret that we have been unable to procure any definite idea of its details, or even of its mode of working. By it however the metal is wrought into the most eccentric shapes, without any further intervention of human hands than is requisite for superintending the machine. Owing to this skilful arrangement of machinery, only thirty-five men are required to carry on the works, turning out nearly three thousand rifles a year, worth about thirteen dollars a piece. In the manufacture of these about 50,000 pounds of iron, 6,000 pounds of copper, and from 4,000 to 5,000 pounds of steel, are annually consumed. The steel is worked up into ramrods, springs, and portions of the lock. The iron costs about one hundred and forty dollars per ton, and is obtained from Salisbury, Connecticut—that procured there being found of a superior quality to either the English or Pennsylvanian iron. The stocks are made of black walnut, which is brought from Pennsylvania. The rifles, when finished, weigh ten and a half pounds each. A striking advantage gained by the extended use of machinery in making the different parts of the rifle, is the perfect uniformity of the work. So accurately, and in so many different ways, is every part, even the most minute, gauged, that in putting together the whole, no delay is occasioned from trifling inaccuracies in fitting. Each screw, spring, sight, topboard, or any other piece whatever, is so nicely wrought, that it may be applied to and will fit any one of the three thousand rifles made in the course of the year as exactly as it does the one of which it finally forms a part. The rifles are made on contract for the Government, and are not offered for sale."

APPENDIX.

ARTILLERY.

The following articles, extracted from "an American" publication, so completely agree with our views on Artillery and "Metals," that we have thought it valuable to transcribe them entire, as they condense many valuable data.

COMMUNICATED FOR THE "BALTIMORE PATRIOT."

Folly of Admiral John Tyler, Commander-in-Chief of the Land and Naval Forces of these United States.

If any doubt existed as to the utter incapacity of his excellency to be entrusted with the command of the Land and Naval Forces of the Republic—the annexed official order, after a full knowledge that the two Big Guns on board the *Princeton*, constructed at seven times the cost of cast-iron, had cracked and burst with unparalleled loss of life—the most sceptical will be convinced, after reading the Congressional documents, that he is a qualified candidate for admission to a Lunatic Asylum.

It appears from the record, that it was not until the first gun constructed in England by Captain Stockton, on his own individual account, had cracked, that the Government became the purchaser; and with the knowledge of the fact, a second was ordered to be constructed at an expense of 11,488 dollars; after the bursting of the second, a third is ordered without reference to cost.

Is not this an impeachable offence? I submit the question to the decision of Chancellor Kent.

WASHINGTON, March 14, 1844.

Being entirely satisfied, from the report of the late Court of Inquiry, that no vestige of pretence remains to visit the slightest censure on the officers and crew of the Princeton, either collectively or individually, for the sad and melancholy accident which has occurred on board that ship; and regarding the bursting of the gun as one of those incidents which have often before attended the use of cannon of every size and description; and being firmly impressed with the great importance of the Princeton as a ship of war, it has therefore seemed to me to be altogether proper to direct the construction of another gun of the size and dimensions of that lately destroyed.

I have, therefore, thought proper to order that such a gun be wrought, under the direct supervision of Captain Stockton, as soon as may be; and that the same be paid for out of any unexpended balance remaining of the appropriation for navy ordnance.

JOHN TYLER.

To the Secretary of the Navy.

ACCIDENT ON STEAM SHIP "PRINCETON."

MAY 15, 1844.

Read and laid upon the table, and 2,000 copies extra ordered to be printed.

Mr. PARMENTER, from the Committee on Naval Affairs, made the following

REPORT:

The Committee on Naval Affairs, to whom were referred certain communications from the War and Navy Departments on the subject of large wrought-iron guns, and in pursuance of the duty assigned them by the House of Representatives, submit the following Report:

IT appears that these guns were purchased by Capt. Robert F. Stockton, without any express order from the navy department; and, as far as can be learned by the committee, the building of the Princeton, and the procurement of her armament, were under his direction. One gun was procured from iron works in England, the other from an American establishment. From all the papers reported to the House, and furnished on the calls of the committee, they do not find that any of the proper officers of the government had anything to do with the guns, except to direct them to be proved, and to agree to the payment of the bills of cost after they were procured.

Neither do the committee learn that the construction of the Princeton was supervised by the officers of government charged with that branch of the public service. Everything seems to have been left to Captain Stockton, to enable him to carry out his own peculiar views.

These guns were not ordered, originally, by the advice of the ordnance department of the navy, as would seem to be the proper course—that being the branch of the service instituted by law for the regulation of the naval armament. Bureaus are established, and scientific officers placed in charge of them, for the purpose of enabling the executive department to be possessed of the means of deciding with the advantage arising from the skill and attainments of competent officers in the different branches of the public service. It was irregular to permit an officer, unconnected with the construction or ordnance department, to proceed with so little restraint in the building and arming of a ship of war, as was the case with regard to the Princeton.

By other documents communicated with this report, it will be seen that, on the 14th day of March last, the President of the United States ordered another gun of the size and dimensions of that lately destroyed to be made "under the direct supervision of Captain Stockton." This gun, the committee are informed, is in a state of forwardness, and, it is supposed, will be finished in August next.

The committee have no disposition to advise an interference with the duties of the Executive, by undertaking to prescribe the exact mode of arming our public ships. But they feel bound to express the opinion, that an unusual species of armament, attended with danger, should not be introduced into the public service, until it receives the full approbation of the ordnance officers, as to its efficiency and safety. It may also be a question, in consideration of their great cost, and the fact that, so far as our navy is concerned, they are an experiment, whether these large guns should not be superficially directed by Congress before they are procured.

The committee do not, however, propose any legislation at the present session. They trust that the sad event which has given rise to this investigation, and the information elicited by this inquiry, from intelligent ordnance officers, will lead to cautious proceedings in a matter of such importance to the success and reputation of the navy, and one in which the lives of those engaged in the public service are so deeply concerned. The committee ask to be discharged from the further consideration of the subject.

Extract from the Report of the Naval Court of Inquiry, convened by Order of the Secretary of the Navy.

After much deliberation and several consultations, with calculations furnished from the same quarter, Captain Stockton determined upon the construction of a gun of the proposed dimensions, for the purpose of testing the opinions of scientific men by the results of experience. A cannon was accordingly made at the Mersey works, of Yorkshire iron, which, being approved of, was shipped to the United States. Having been properly prepared for the purpose, this gun was carried to Sandy Hook, and subjected to what was deemed the proper test. After the first fire, preparations were made to mount the gun; in doing this, a crack was perceived opposite the chamber, which induced Captain Stockton to have the breech strengthened by putting bands around it. These bands are represented as being 3½ inches in thickness. With this additional strength given to the defective part of the gun, the experiments were renewed, and the result was a decided conviction upon the minds of all connected with them, that, in general, the anticipations of Captain Stockton were perfectly realized; and, secondly, that if a gun of this construction should yield to the force of the trial, it would be by a simple opening, and not, as in cast iron, a violent disruption and scattering of the fragments. The success of these experiments was such as to decide Captain Stockton forthwith to direct the construction of another gun of a similar character, to be made of American iron, which is usually regarded as superior in strength and tenacity to the English iron. This second gun (the same which exploded on board the Princeton) was constructed with a chamber similar to that of the first gun, with an additional thickness of twelve inches at the breech—a difference (even if the metal were only of equal goodness) far more than sufficient to compensate for the bands by which the first had been fortified.

Extract from an Official Report of the Board of Ordnance to the Secretary of War.

By direction of the Secretary of War, some six-pounder guns have been manufactured, in 1843, according to a new method, which is not divulged, at the same price as bronze guns, and promising to unite the advantages of wrought with those of cast iron. These guns are now at Fort Monroe arsenal, where the experiments to test their strength and durability are in progress. They are not, however, completed; and although, of those tried, one failed at the 150th fire,. by the trunnion band becoming loose, and another at the 450th fire, by the opening

of the welds, the results, so far, are not sufficient to warrant a definite conclusion as to the merits of this mode of fabrication.

So far as it has been tested by this department, wrought iron has not proved a good material for the manufacture of field guns; and as the difficulty of fabrication increases with a greater quantity of metal, it is less suitable for those of larger calibre. The greatest objection, and apparently an insurmountable one, is the difficulty of welding the parts together perfectly, and still greater difficulty or impossibility of ascertaining whether the welds are perfect or not. Besides, the effect of heating is to render the iron more porous, and of less specific gravity and tenacity; and, when often repeated, is known to destroy the good qualities of the best refined iron. When the bars are of small size, as in gun barrels, the hammering compresses and re-unites the particles, and corrects these defects; but in large masses, the effects of the hammer do not reach the interior of the mass, which is consequently left open and spongy, although the metal on the surface, and to a slight depth, is compact and fibrous.

Leaden balls are used in small arms; but they are inadmissible in cannon, as the great heat of the exploded gunpowder melts the lead more or less, and changes the form of the ball, thereby reducing its range; besides, lead has not sufficient tenacity to enter hard substances, and therefore is not a suitable material to be used against ships and batteries. Wrought iron is also more liable to injury from rust than bronze or cast iron; and the smallest crack admitting moisture, would of itself, in time, seriously injure the gun.—The first cost of wrought iron cannon is the same as that of bronze, and more than six times that of cast iron. Bronze guns, it may be further remarked, after being too much worn for service, can be easily recast; whereas the old wrought iron is useless for refabrication, and of little value in such large masses for any purpose.

In regard to the experience of European powers on this subject, it may be stated generally, that the use of wrought iron as a material for cannon has been attempted in Europe repeatedly, without success, from the invention of fire-arms to this time. The cannon of small size have succeeded better than larger ones; indeed, there is no known record of a wrought iron gun for heavy shot proving satisfactory. The works of European writers on artillery abound in notices of wrought-iron cannon, of dates of manufacture extending back from the present century to the remotest periods of their use.

Frequent instances of accidents from their bursting are mentioned, and they have never been successfully manufactured on a large scale. Meyer, in his work, entitled "Experiments in

the Fabrication and Durability of Cannon, both Iron and Bronze," edition of 1834, says: "It is certain no experiment in artillery has been as often unsuccessfully repeated and abandoned as the fabrication of wrought-iron cannon; and even at this time we are but little further advanced in it than at the beginning;" and Gassendi, in his "Aide Memoire d'Artillerie," edition of 1819, condemns the use of wrought iron for the manufacture of cannon entirely.

Herewith are submitted extracts from different writers, containing a chronological history of wrought-iron cannon, and remarks on the use of this material for their fabrication.

The British troops, in the Peninsular war, on several occasions found their siege trains of bronze speedily rendered unserviceable, and resorted to cast-iron guns; the superiority of which, over bronze, consisted in their greater accuracy, and being less heated in rapid firing; and they are stated to have endured 2,700 discharges. "These pieces had preserved such accuracy of fire, that in the last days of the sieges they were fired from a great distance over the heads of the besiegers at the breach, with sufficient precision to reach the besieged behind a high rampart."

According to Vassius, the Chinese had, in the year of 1055, cannon of bronze and wrought iron, which were worked with much skill.

A wrought iron cannon was found in the ruins of the castle of *Uf Ugher* on the Rhine, which castle was destroyed in the year of 1308.

In the year 1338, the Teutonic order had three bombards of wrought iron.

At the siege of Eu, in 1340, the English had large wrought-iron pieces, with which they threw round stones.

According to Villani, the English, in 1345, had wrought-iron cannon before Monsegur. Darrel says that there are indications of the existence of wrought-iron cannon and of powder at Toulouse at this time.

In 1494, Charles VIII. suppressed entirely wrought-iron bombards, and had no other artillery than that of bronze.

In 1697, there were made some wrought-iron pieces, composed of bars wrapped round a core. An eighteen-pounder of this kind burst at the first fire.

1828. Horton takes out a patent for wrought-iron cannon. The wrought-iron cannon made at Gleiwitz in 1812 is proved. It becomes much heated, and cracks; but sustains, notwithstanding, a great number of charges, with ball, and a charge of powder half the weight of the ball.

1830. A cannon made of bar-iron wrapped spirally, and soldered with copper, does not sustain the proof-fire.

From "Experiments in the Fabrication and Durability of Cannon, both Iron and Bronze," collected and arranged by Moritz Meyer. Paris edition of 1834.

It is certain that no experiment in artillery has been as often unsuccessfully repeated and abandoned as the fabrication of wrought-iron cannon; and even at this time we are but little farther advanced in it than at the beginning. It is known that the cannon which were called bombards were composed of bars of iron, held by circles, like the staves of a cask; shortly after they were brazed together. At this time their chief use was to fire against cities; and as there was, consequently, little need of accuracy of fire, and the powder was weak, and the projectiles of stone, these clumsy and badly-made machines were sufficient; they did, however, frequently burst; as, for example, at the siege of Constantinople by the Turks, where a bombard firing stone projectiles of 480 kilogrammes (1,056 pounds English) weight, burst at the first fire, and killed many persons. James II., King of Scotland, was killed at the siege of Roxburgh, in 1460, by the bursting of a bombard. Ancient writers, such as Miethen, Sardi, &c., relate that wrought-iron cannon frequently burst in rapid firing.

Subsequently, cannon seem to have become more defective, as the artillery corps became better instructed. Guns of large calibre were abandoned, which facilitated the fabrication; but, at the same time, greater exactness was required, and cast-iron balls were introduced; a greater number of pieces were used, and the firing was more rapid; whence the fabrication, already defective and difficult, became more so. It was then increased by the introduction of trunnions. But, in consequence of the great uncertainty of the results of the different welding heats, which often burnt the metal in some of its parts, the fabrication of wrought-iron cannon was abandoned in the middle of the fifteenth century, for the introduction of cast iron. Nevertheless, reckoning on the progress which had been made in the art or metallurgy, it was resumed in later times, with the hope of overcoming the difficulties which had formerly been regarded as insurmountable. Thus, in the 16th and 17th centuries new experiments were undertaken, but after a new method. Massive cannon were forged by means of *skelps* suitably prepared. The archives of the arsenal of Paris mention a twelve-pounder wrought-iron cannon, weighing 1,600 pounds, made in this way in 1752. There are to be seen at the museum of the artillery school of Strasbourg, four wrought-iron pieces, weighing from 90 to 100 pounds; one of which bears the date 1601.

At the commencement of the last century, new attempts were

made in France to introduce the manufacture of wrought-iron cannon by a new process. It was proposed to envelop them with solid bands. A very high price was asked for cannon made in this way, under the pretence that they must offer great advantages, because the direction of the fibre of the iron was perpendicular to the axis of the gun, where the greatest strain from the ignited powder was exercised.

St. Remi, in his Memoirs, mentions the process followed on this occasion; but he adds, that notwithstanding the assurances of one of the manufacturers, of the excellent quality of an eighteen-pounder, which he presented, it *burst at the first fire into two pieces, and killed and threw into the Seine many persons.* He also mentions a wrought-iron cannon composed of seven pieces, which offered the advantage of easy transportation; but he adds, that it burst into small pieces at the proof.

From Gassendi's Aide Memoire. Paris edition of 1819.

But these wrought iron pieces, and others like them—are they good? Ought they to be adopted? No. Because—

1st. They soon destroy the carriage, by the suddenness and length of the recoils.

2d. Because of the serious inconvenience to those serving the pieces, from the length of the recoil.

3d. On account of the alteration in the ranges, by the continual and inevitable oxidation of the bore.

4th. The moral effect on the gunners, from the fear of their bursting.

In fact, these pieces often burst, although the first which are presented by the inventors for proof do not always do so, because they use for them selected metal, and carefully watch their fabrication. But, in making a number, it is to be hoped that the metals will be as scrupulously selected, and that an observing and practised eye will watch over the degrees of heat which the metal ought to have, in order to work solidly the immense number of welds necessary to finish the piece; then, from firing, the imperfect welds will be imperceptibly opened; moisture will penetrate the fissures, which, increasing to a certain extent, will cause the gun to burst; exfoliations will be formed in the bore, which will retain fire and cause accidents. Finally, the irremedial oxidation of the bore in time of war will so enlarge it, as to render the guns unserviceable, and in time of peace there will be the trouble of keeping them constantly painted to prevent this oxidation. We have been thus profuse on the defects of these pieces, to answer, once for all, an innovation

which appeared good, and which is often represented as something new.

Mr. Rhodes, a skilful and practical naval constructor, who was employed for some time by the Turkish Government, states that there are in the arsenal at Constantinople many wrought iron cannon of calibres varying from 100-pounders to the smallest sizes.—These guns have all been thrown aside, and are no longer considered as suitable for service. By direction of the Sultan, some of them have been cut up, both in cross sections and longitudinally, to ascertain the manner of their fabrication. They were found to be composed of bars surrounded by bands, like the staves and hoops of a cask, the whole welded together—those of larger size being formed on a *mandrel*, and the smaller ones forged solid and bored out. They were composed of successive series of these bars and hoops, laid on each other, to make the requisite thickness of metal; and the junctions of these layers, as also of the bars and hoops of the same layers, were distinctly perceptible. The defects were enlargements and batterings of the bores, arising from the effects of the charges on the soft metals composing the guns.

Respectfully submitted:
G. TALCOTT,
Lieutenant Colonel Ordnance.

Ordnance Office, Washington, April 5, 1844.

Again, says this report: "Guns of this material (wrought iron) were the first used; and they have been tried, at various periods since the first invention of gunpowder, and always without success.

"The first and greatest objection is, the difficulty of welding the parts together perfectly, and the still greater difficulty of determining whether the welds are perfect or not. In the account of a wrought iron gun, tried at Toulon in 1745, it is stated that, after the gun was broken up, the cascabel and trunnions were found to be held only by a portion of the faces which touched. Three-fourths of these faces showed the effects of rust."

It appears from most authorities, that the art of casting guns was esteemed a great improvement upon the more ancient art of forging them, and whatever may have been the cause, immediately superseded the latter. The cause may have been the vastly diminished cost of the cast iron guns, or the facility of manufacture, or the opinion of greater security and certainty in the use: or, probably, the combination of all of these. Certain it is, that the forged guns went entirely out of use.

That wrought iron guns, constructed of iron bars, hooped together, were used very generally, we know from the specimens yet preserved, and the facts of history. James the Second of Scotland lost his life before Roxburgh castle, by the bursting of one of these guns. In 1545, a man-of-war, named the "Mary Rose," commanded by Sir George Carew, sunk off the Isle of Wight, with her whole crew. Three hundred years nearly after the accident, Mr. Dean, with his diving apparatus, raised a twenty-four-pounder brass gun, and, at the same time, iron guns. The iron guns were formed of iron bars, hooped together with iron rings; and they were all loaded, &c.—*Wilkinson's Engines of War.*

"The objections to the wrought iron guns are continued thus:

"1st. They promptly destroy the carriages, by the suddenness and extent of the recoil.

"2d. They incommode greatly the troops by the length of the recoil.

"3d. They will change their range greatly, by the continued and inevitable oxidation of the bore.

"4th. They enfeeble the moral of the cannonier, by the continued apprehension of their bursting.

"In fact, these guns often burst, although the first pieces furnished the company for proof did not always burst. We have thus dwelt at large upon the defects of wrought iron guns, in order to reply, once for all, to the pretensions of an invention which claims to be good, and is often represented as new."—*Aide-Memoire,* volume 2, page 784, &c. Paris 1819.

It appears that wrought-iron guns have been made from the earliest times, and were, until superseded by the introduction of cast-iron and bronze cannon, the principal artillery in use; that at different periods since the general use of cast guns, efforts to construct serviceable cannon of wrought iron have been made by the principal European powers; and that, whatever may have been the cause, they have not been again employed in active warfare. The inference is, therefore, although no further information than the foregoing is in the possession of this bureau, that they have not been used for good and sufficient reasons.

The two wrought iron guns on board the steamer "Princeton" being the only guns of that description ever used in the navy, no opportunity has been afforded this bureau of ascertaining the relative strength and utility of wrought and cast iron cannon.

All of which is respectfully submitted.

I have the honor to be, very respectfully, sir, your obedient servant.

W. M. CRANE.

Hon. John Y. Mason, Secretary of the Navy.

Extract from Capt. Stockton's Report, Dec., 1842.

Nothing has heretofore depended more on the blind chance of fortune than a sea-fight. I have endeavoured to reduce the art of gunnery to something more certain in practice, and more satisfactory in science. Considering the means at my disposal, something, in my judgment, has been accomplished. I only ask you to compare the plan adopted for these experiments, the expense and the results, with any others that have been made, and say whether another gun should not be at once put in hand, and all other appliances prepared as soon as possible, so as to confirm what has thus far been developed.

The wrought iron gun was strengthened by bands shrunk on after the gun was made In consequence of two of these bands having been put on too tight, they have cracked by the jar of the explosion. I will have one of them taken off, that Commodore Wadsworth may see how perfect the gun is under them, and will have others put in their place.

Report of Capt. Wadsworth, Inspector of Ordnance.

Flushing, N. Y., December 21, 1842.

Sir,—I have the honour to inform you that I have made an examination of the twelve-inch wrought-iron gun of Captain Stockton, now at the Phœnix foundry in New York. On the interior of the gun is a crack on the upper part of the band which connects the trunnions to the gun; a crack on the under part of the body of the gun in the reinforce. One of the bands which have been put on to secure the gun in this part, has been cracked, and is taken off; and both the arms of the breeching-cleat, formed on the screw-nut of the bolt through the breech, are slightly cracked. The band connecting the trunnions was put on the gun when heated, and shrunk on very tight—so much so, as to compress, the metal of the gun in this part. *The fracture of it, I learn, took place on the first discharge of the gun, in Philadelphia, with a blank cartridge, since which*, it has not altered. It does not extend the whole width of the band. Its depth cannot be ascertained. This band was

not put on for the purpose of strengthening the gun, but for securing the trunnions, which remained firm. It is about 11 inches in width and about 2½ inches in depth or thickness. The band which has been taken off from the reinforce, was one of four which were put on over a rent which appeared, and to strengthen the gun in this part, and are each nearly 9 inches in width and 2¾ in depth. These bands were also put on the gun hot, and shrunk on, and it being probably tighter than the others, and owing to the extreme tension of the metal, it broke from the concussion of the gun after a number of discharges—how many, I am not informed. These four bands were placed contiguous to each other, and so neatly finished that their joints could not be distinguished, and in appearance formed one band. The rent in the solid part of the gun is barely perceptible when it is uncovered by the displacement of the band. Its extent I cannot tell; but I should judge that no alteration had taken place since the band was put on, and that the band was broken by the concussion, rather than by any opening or enlargement of the gun itself.

United States ship, Princeton.

New York, January 16, 1844.

Sir,—I have the honor to inform you, that I yesterday *proved* the big gun with the following charges.

1st	charge	14	pounds	powder.
2nd	"	14	"	"
3rd	"	20	"	"
4th	"	25	"	"
5th	"	45	pounds	powder, and 212½lb. shot.

The powder used was 276 yards proof, which makes the *true proof* applied to the gun 49 6-10 pounds.

As a gun, it is quite perfect, and I do not think that *any* charge of powder can injure it; and as a piece of forged work, it is certainly the greatest achievement up to this time. It is safe in its carriage on board of the ship, and I hope within ten days, to be with the ship at Washington.

Most respectfully, your obedient servant,

R. F. STOCKTON.

P. S.—The men who made it deserve their money. It is worth all the guns on board of any frigate.

Note.—The large gun weighed 27,334 pounds.

Statement of cost (as paid by the Bureau of Ordnance and Hydrography) of the wrought-iron cannon made under the directions of Capt. R. F. Stockton, United States Navy.

	dollars	cents
Paid requisition of Thomas Hayes, Navy Agent at Philadelphia, dated 10th August, 1842. ..	3,600	00
Paid amount of Hogg and Delamater's bill, approved by Capt. R. F. Stockton, for work done on wrought-iron cannon	1,600	36
	5,200	36

Bureau of Ordnance and Hydrography, April 1, 1844.

W. M. CRANE.

Statement of cost (as paid by the Bureau of Ordnance and Hydrography) of the second wrought-iron cannon made under the directions of Capt. R. F. Stockton, United States Navy.

	dollars	cents
January 20, 1844.—Paid requisition of Thos. Hayes, to pay bill of Hogg and Delamater, approved by Capt. R. F. Stockton, for wrought-iron cannon ..	9,914	95
March 18, 1844.—Paid bill of Hogg and Delamater, approved by Capt. R. F. Stockton, for labour, &c. on wrought-iron cannon..	1,573	27
	11,488	22

Bureau of Ordnance and Hydrography, April 1, 1844.

W. M. CRANE.

The true value of all these opinions may be formed from the fact that ten valuable lives were sacrificed by this at best foolish experiment; all will end so sooner or later.—AUTHOR.

LOADING AT THE BREECH.

Some very successful experiments were made in Woolwich Marshes on Friday (17th inst.) with two 24 pounder guns loaded from the breech, constructed according to a plan invented by Baron Wahrendorff, of Stockholm. We quote the following account from the *Times*.—"Eight rounds only were fired at a range of 1,250 yards, four of the shot being covered with a thick kind of serge, and four with lead about two-tenths of an inch thick. The object to be gained by Baron Wahrendorff's invention, is to be able to load the guns used on board of vessels at sea from the breech, many valuable lives having been lost during the last war, by the difficulty of running out and in the guns when naval engagements took place. The loading at the breech is effected on this plan,—by having the gun bored all through, and after putting in the ball first from the breech end, then the charge of powder, and lastly, a chamber amply secured and air tight, that no danger may occur at the rear. The firing was good, the second ball entering the target at the long range

of 1,250 yards. The charge of powder was two pounds less on each round, and it was found to give the shot a greater elevation than by the common practice, which was easily accounted for, as the covering of lead gave less windage. It was observed that the shot covered with lead caused a recoil of about a foot more than the recoil of the gun charged with shot covered with serge."—*August*, 1842.

BURSTING OF GUN BARRELS.

The following quotations explain scientifically and so clear this question, what many have hitherto little understood, that no apology is required for their introduction.

"If a gun is loaded with ball, it will not kick so much as when loaded with small shot, and amongst different kinds of shot, that which is the smallest causes the greatest recoil against the shoulder; a gun loaded with a quantity of sand equal in weight to a charge of snipe shot, kicks still more. If, in loading, a space is left between the wadding and the charge, the gun recoils violently or bursts. If the muzzle of a gun has accidentally been stuck into the ground, so as to be stopped up with clay, or even with sand, or if it be fired with its muzzle plunged into the water, the almost certain result is, that it bursts.

The ultimate cause of these apparently inconsistent effects is, that every force requires *time* to produce its effect, and if the time requisite for the elastic vapour within to force out the sides of the barrel, is less than that in which the condensation of the air near the wadding is conveyed in sufficient force to drive the impediment from the muzzle, then the barrel must burst. It sometimes happens, that these two forces are so nearly balanced, that the barrel only swells, the obstacle giving way before the gun is actually burst.

The correctness of this explanation will appear by tracing step by step, the circumstances which arise on discharging a gun loaded with powder confined by a cylindrical piece of wadding, and having its muzzle filled with clay or some other substance, having a moderate degree of resistance. In this case, the first effect of the explosion is to produce an enormous pressure on every thing confining it, and to advance the wadding through a very small space. Here let us consider it is at rest for a moment, and examine its condition. The portion of air in immediate contact with the wadding is condensed, and if the wadding were to remain at rest, the air throughout the tube would soon acquire a uniform density. But this would require a small interval of time; for the condensation next the wadding, would travel with the velocity of sound to the other end, from whence being reflected back, a series of waves would be gene-

rated, which, aided by the friction of the tube, would ultimately destroy the motion.

But until the first wave reaches the impediment at the muzzle, the air can exert no pressure against it. Now if the velocity communicated to the wadding is very much greater than that of sound, the condensation of the air immediately in advance of it, may be very great before the resistance transmitted to the muzzle is at all considerable; in which case the mutual repulsion of the particles of air so compressed, will offer an absolute barrier to the advance of the wadding.

If this explanation be correct, the additional recoil when a gun is loaded with small shot or sand, may arise in some measure, from the condensation of the air contained between their particles, but chiefly from the velocity communicated by the explosion to those particles of the substances in immediate contact with the powder, being greater than that with which a wave can be transmitted through them. It also affords a reason for the success of a method of blasting rocks by filling the upper part of the hole above the powder with sand instead of clay, rammed hard, that the destruction of the gun barrel does not arise from the property possessed by fluids, and in some measure also, by sand and of small shot pressing equally in all directions, and thus exerting a force against a large portion of the interior surface, seems to be proved by a circumstance mentioned by Le Vaillauf, and other travellers, that, for the purpose of taking birds without injuring their plumage, they filled the barrel of the fowling-piece with water instead of loading them with a charge of shot.

The same reasons explains a curious phenomena which occurs in firing a still more explosive substance. If we put a small quantity of fulminating silver upon the face of an anvil, and strike it slightly with a hammer, it explodes; but instead of breaking either the hammer or the anvil, it is found that that part of the face of each in contact with the fulminating silver, is damaged.

In this case the velocity, communicated by the elastic matter disengaged, may be greater than the velocity of a wave traversing steel; so that the particles at the surface are driven by the explosion so near to those next adjacent, that when the compelling force is removed, the repulsion of the particles within the mass drives back those nearer to the surface with such force, that they pass beyond the limits of attraction and are separated in the shape of powder.

The success of the experiment of firing a tallow candle through a deal board, would be explained in the same manner, by supposing the velocity of a wave propagated through deal

to be greater than that of a wave passing through tallow. This reasoning ought, however, to be admitted with caution; and perhaps some inducement to examine it carefully may be presented by tracing it to extreme cases. It would seem—but this is not a necessary consequence—that a gun might be made so long that it would burst, although no obstacle filled up its muzzle. It should also follow that if after the gun is charged, the air were extracted from the barrel, though the muzzle be then left closed, the gun ought not to burst. It would also seem to follow from the principle of the explanation, that a body might be projected in air, or other elastic resisting medium, with such force that, after advancing a very short space, it should return in the same direction it was projected."—*Babbage on Manufactures*, page 23 to 26.

"When the same charge of powder is used, and the same ball as to size and weight, the extent of recoil of a gun is less in the proportion in which the weight of the gun is greater, for the whole momentum of the gun in recoil must remain unaltered, that is, the product of the velocity of recoil multiplied by the weight of the gun, must remain unaltered in the supposed different causes, which it cannot do without one term of the product, namely, the velocity by recoil diminishing in the proportion in which the other term, namely, the weight of the gun increases. It appears, therefore, that if the weight of a gun be doubled, the recoil will become only one half of what it was before, and so on; the recoil of the same is increased by using a larger quantity of gunpowder than common for the charge, and by the same charge of stronger powder, by the same charge also when the powder is in a better state for ignition, from the warmth and dryness of the weather, or from the heat of the gun itself, it is increased by having a particular tight wadding and by allowing the gun to remain loaded for any length of time."—*Inman.*

OBSERVATIONS ON GUNPOWDER, SHOT, WADDING, AND PERCUSSION CAPS,

BY WILLIAM GREENER,

Author of "The Gun," and "The Science of Gunnery."

PRECEPTS are more deeply impressed upon the mind if they are inculcated at seasons when practice proves their truth. For the admirers of shooting, the period of their sport has arrived,

and ere this meets the eye of the sportsman many will have essayed their skill, counted their numbers bagged, and numbers missed, and guns, powder, shot, and dogs will, no doubt, have their share of blame. Advice to sportsmen stares you in the face on every page of every sporting index: so often, and so well too, has the subject been handled, that it is nearly threadbare; and few now can add to it anything genuinely original. I do not propose attempting anything of the kind; but I will endeavour to lay old subjects before my readers in somewhat new garbs. I would impress upon the sportsman the value of adopting the advances science has made in projectile force, and projectile bodies; so that in his pursuits of pleasure he may enhance his enjoyment by the knowlege he has perfected of the collaterial agencies which are to aid him in securing the "gory fluttering pinion." On the great return of the auspicious day (after, to so many, a sleepless night), the tyro too frequently goes forth armed with a tube, or tubes, the production of some clever maker, warranted to destroy, and never to miss, provided the nerve and eye are true. And though, withal, disappointment thrusts in his officious face, claiming companionship, and, satan-like, suggesting other causes for the defeat of hope than the right ones, as the collateral agents are alone pronounced to blame, I, therefore will proceed to offer some remarks on powder, felt, shot, and the electric fluid, with a view to place the fiend disappointment on his own saddle, and point out the means of insuring success, by adopting the necessary concomitants.

Within the last fourteen years gunpowder has undergone so great a change, that we may almost say its nature and principle are entirely revolutionized; chemistry and mechanics combined have made this change: chemistry has purified the nitre, the great explosive agent; and mechanical process has fitted it, by granulation, for all and every purpose to which its tremendous power can be beneficially applied. It is capable of lifting the mountain, and can be controlled as easily as the vapour of water: wonderful are its effects, exceeded by no known agent; and yet science clearly shows it so simple in principle, that she appears to exclaim, "Why do I give you a power that you will not take advantage of, but be content with a certain quantum of aid, when you might get it *ad infinitum*?" The *gun* is, at the present period, the only agent to which success, or the want of it, is ascribed: but science shews the best constructed barrel is that which has a tendency to destroy the least portion of the expelling fluid; and, in destroying less, leaving the greater surplus to expel the projectile bodies. The last and the present generation have studied only the improvement of the gun, and

science in that art may be said to have here reached almost its limit, little of the hill remaining to be climbed, save what is encumbered with the stumblingblocks of prejudice, placed injudiciously, and marked, for notoriety, with the name of the placer. Science has shewn us that gun-barrels, to be good, must be hard, dense, and so nearly cylindrical in the tube, as to offer no unnecessary resistance, and admit no means of wasting the quota of force generated, by useless friction. Science has taught us that the force, the power, of gunpowder is limited; that one "drachm" possesses but adefinite quantity of force, which we should so arrange as to get the greatest good the means will yield us. Granulation of gunpowder is the road to advantage; and, in treating of it, let us study the many circumstances that affect it.

We have shown that gunpowder burns quickly, so quickly, indeed, as to be excelled, in that respect, only by fulminating powder.* Now the established laws of nature clearly tells us that bodies cannot be put in motion but by a graduated scale; and that scale must be influenced by the quantity of force exerted, and the weight of the body resisting. Therefore, the necessity of granulation in gunpowder is, that it may acquire an explosive property by the aid of the interstices, and generate a preponderating force to give the velocity required to the projectile body. No ball can in a short distance acquire a great speed; and hence the necessity for length of tube in a gun-barrel. But again, in the present system, the extremely fine grains of powder, possessing in themselves but the merest quantity of explosive matter, the whole is burnt out while the flame travels but a fifth of the length of the barrel; and thus, in a manner, only kicks the shot before it; and the immense resistance the condensed air in front opposes, after the propelling force has reached its greatest maximum, reduces the force, by neutralizing the effect of the kick. If we are to remain in the present position, I would advise all sportsmen to cut their barrels to half the length they now are, for they would kill as far, and quite as well, as if twice as long. But this is supposing a stand-still in science, which few, I presume, will advocate; therefore we must fit the powder to the gun, and not the gun to the powder, as the present adopted lengths are, at any event, best for the first of September. Experience and experiment have clearly shewn that all the finer powders burn too quickly, and, as before stated, only kick out the shot; and, admitting these premises, it becomes a question how and where can we get it more suitable? Pigou and Wilks, No. 2 grain

* See "The Science of Gunnery."

for percussion guns, I have found to be vastly superior to the finer; and yet *it* is too small; not burning more than half the distance in a two-feet-eight-inch barrel; leaving the remainder to reduce the explosive power given. Gunpowder makers are, like the generality of tradesmen, content to remain as they are, so long as grist comes to their mill. Our gunpowder is, from its very purification, much quicker than it could be during the flint-gun era; then, if so, whence arises the fact of killing farther formerly. Velocity is force: then, having velocity, why have we not range? I have shewn it can be had, if we get sufficiently accelerative power. Grains of powder, with a sufficiency of matter to burn during the period the projectiles are being driven along the tubes, to overcome the resistance of the atmospheric fluid, which increases in force the nearer it comes to the muzzle of the gun, will completely effect this, and give us, at the very instant we should have it, the greatest velocity to the shot, and enable us to kill farther, and better, by effecting death with the least possible pain. Quantity, too, will be saved, as no addition to the charge of fine powder can be made beneficial, unless it is so great as to render it both dangerous and unpleasant. Three drachms of larger-grained powder will invariably effect, in a given size of gun, as much as three and a half drachms of extremely fine grained, and with considerably less recoil: how is this? The same weight contains the same quantity of expansive matter; and dissimilarity in result is accounted for solely by the fact, that bounds are set by nature in the action of her elements in offering greater resistance, the greater the violence with which the atmospheric air is attempted to be displaced. Granulation of gunpowder produces a power which overcomes the resistance of the aeriform fluid, by keeping up the pressure until the bodies in motion have obtained the requisite force. I shall pass the present question with an earnest hope the scientific shooter will try this theory, calmly, ere he condemn it, and by adding his assistance, effect the necessary change required to place gunnery, as it ought to be, in a state of perfection.

Wadding is a mechanical means of separating the explosive fluid from the bodies to be projected by it. I have often thought this might have suggested the piston in the steam-cylinder, for the wadding in a barrel is a species of piston; and being in use long anterior to the former, could not have been borrowed from it; but the reverse might have been the case. The felt wadding has kept its character well, being unquestionably the best ever yet produced. We have, certainly, had it so thick, that, instead of being just sufficient for the purpose, the reverse is the case, producing unnecessary friction, and thus

lessening the propellant force. F. Joyce was the first to perfect this; and, with no wish to puff that gentleman, I must say his wadding has not yet been exceeded. The application of a greasy substance to the edge cleanses the barrel sufficiently, every shot, to allow the gun to be fired nearly double as often as it could be fired if wadded without grease. The softness and strength combined are highly requisite to make the piston (if the term may be allowed) sufficiently tight in the tube, and yet strong enough to bear the propulsion of the fluid and weight of the shot. All wadding used upon the shot should be as thin *as possible*, having, at the same time, strength enough to offer to the column of condensed air a firm front, protecting the body of small projectiles from its injurious tendency, which is very apparently displayed by using a wadding that separates during the explosion, and permits the air to mix with the shot, thus causing it to diverge immediately it becomes free from the compression of the tube. I prefer a good pressed pasteboard to anything I have yet tried, as it is light and firm. Joyce's thickest wadding should never be used on the top of the charge, as it is unnecessarily heavy, and, as such, disadvantageous. I am aware he manufactures a thinner kind, but *it* is still too thick; and if it were thinner, I fear it would not afford the necessary resistance to the air, or keep the charge in the second barrel firm during the recoil from the discharge of the first.

The quantity of shot which should constitute a charge, is a question on which much difference of opinion exists. If the truth of the foregoing remarks be admitted—and I think it will be difficult to dispute it—I may safely assert that far too heavy charges are generally used, with a loss of force corresponding to the excess, causing an unnecessary recoil, and a waste of shot also. I have tried a round of experiments for this paper; and, in giving them, I must remark, that I have frequently found, with other guns, a greater disparity in the results here given: and this is by no means an extreme case, but rather below the average. The gun used was 2ft. 8in. long; 14 bore; a pair of steel barrels, perfectly cylindrical to within three inches of the muzzle, where a *very gradual* widening of the bore commences, and continues to the end: the barrels are polished as fine as a looking-glass; in fact, presenting the least conceivable friction:—

Fine-grained powder.	3 drs.,	$1\frac{1}{8}$oz.,	No. 5 shot,	put in 130 pellets.	Round target, 25 in. in diameter.
Coarse-grained do.	3 ..	do.	..	put in 142 do.	
Fine-grained do.	3 ..	$1\frac{1}{4}$	..	put in 122 do.	
Coarse-grained do.	3 ..	do.	..	put in 134 do.	
Fine-grained do.	3 ..	1	..	put in 103 do.	
Coarse-grained do	3 ..	1	..	put in 128 do.	

The above table of results proves two points; first, the advantage of coarse-grained powder, in throwing the shot closer, and sending, of course, a greater quantity of the charge to the mark; secondly, the saving caused by the reduction which may be made in the charge of shot; for there is a loss in pellets, between those thrown into the target and the quantity put into the gun, of 130 per cent., or, as 327 is to 142 nearly. The next reduction in charge, the loss is 100 per cent., or, as 272 is to 134; while the still further reduction is only 90 per cent., or, as 120 is to 218. The much greater force contained in each individual shot is quite equal to the per-centage difference in quantity of pellets; and thus one shot possesses penetrating powers greater than one and a half of the increased quantity. It would, therefore, thus appear, from actual experiment, that no farther argument is needed to point out the advantage of lessened charges of shot, and increased size in the grain of the powder: it speaks in figures, which are indisputable.

It becomes sufficiently clear, that a proper knowledge of the *principles* of gunpowder is a material point towards ensuring success in the use of it; for, while unadapted to the gun, it is productive of results the contrary of those which might otherwise be expected; while the use of properly manufactured explosive matter will very considerably tend to make a bad barrel shoot tolerably well, and a middling good one shoot excellently.

In my work, on "The Science of Gunnery," I have shewn that copper is not at all suitable for the construction of percussion caps, from the fact of its creating, in conjunction with the iron nipple, a certain degree of galvanic action on the powder contained in them, thereby partially reconverting the fulminating mercury into its original state, which will be found to be the case after travelling a few hours in a humid atmosphere, without a change of caps, when it will be observed that, on a gun missing fire, the nipple is filled with a soft, white powder, which is the result of the galvanic action above mentioned. Iron caps would obviate this, and also have the advantage of communicating the effect of the blow of the hammer more perfectly and immediately, and thereby causing a more instantaneous explosion.

THE PRESENT PROOF-HOUSE THE BANE OF THE GUN-TRADE.

The present Proof-company was called into operation in the year 1813, owing to the immense number of common guns required to carry on that infernal traffic—the slave trade. They were manufactured without being subjected to any description of proof whatever. The maker cared not for the mutilation of his fellow-men; profit was his sole care. It was not only to the poor African, but the same quality of article was sold for home consumption, and the many lamentable accidents of nearly daily occurrence, called loudly for some stop to be put to so base a system.

Whether the individuals who first originated the idea of a Public Proof.House were actuated by philanthropic motives, or from a prospect of gain, we shall not stop to enquire. The present state of its management is sufficiently "evil for the day." It is painful to trace the steps of many public bodies, who start with the purest and most patriotic motives. But self "gain" soon displaces all the finer feelings; and love of "country," "philanthropy," aye, *all* is forgotten, in the whirpool of getting money. Such, fellow tradesmen, is the position of the Gun-Barrel-Proof Company of Birmingham at this time. Abuses have crept into the manufacture of gunnery of the most serious nature. Guns are now sent out of Birmingham of a more inferior quality than *were made, even at the time when the dishonesty of various makers allowed them to send out guns unsafe to use;*—when public opinion called for "a proof" by Act of Parliament. Guns are now made from iron *unfit to make fire-irons.* All the care of the maker is now bestowed on obtaining a *cheaper and a cheaper iron still,*—a reduction in cost painful to behold; for it is not called for; there is no competition that requires this; it seems to be a suicidal act of the most foolish nature. But it is more serious in its consequences than being foolish; it is destroying the trade of Birmingham altogether; it is driving away our export trade as we shall fully show before we conclude this Letter.

That guns are sent out of Birmingham, by thousands, that are horribly dangerous, is well known to this *Proof-Company by Act of Parliament.* Men are not so foolish now, as to take for granted that all is good that is backed by Act of the Legislature: and we think it is now as incumbent on those who wish well to the trade of Birmingham to endeavour to effect a *reform* in this society, as it was on the founders to establish it.

Men are apt to enquire if they really receive any benefit from *certain systems of taxation,* and if they find they do not, it is their duty to get rid of them as of a nuisance. The Proof Company taxes the trade, and yields no good in return; it is a *legalized hypocrisy;* a canker in the frame of the gun trade, which must be entirely eradicated, or good bye to it,—it will not endure long. It is to us a matter of minor importance to know that this Corporation shares *splendid dividends* every month;* were we not painfully aware, that this is of trifling importance amongst the evils they are the cause of inflicting upon the trade;—evils of such magnitude, that it is difficult with our limited means of description to pourtray them.

The first, and one of the most importance, is this:—*they are the sole cause of the falling off in the Birmingham Gun Trade;* which we think, there can be no doubt *has* fallen off, not in quantity, but in quality! Why it is too well known to admit of a question; and should it be doubted that we have reduced in the former, the enormous loss to the district by the reduction in value tells the same tale; so much less money to be spent, if we make now 60,000 guns for the same money we formerly made 40,000, have we gained? no, we have lost It has made men become slaves; guns are not generally made by machinery; we cannot multiply them as they do *spinning jennies;* and if you press down the price, you do it only by the expenditure of more blood and bone;—you drag it out of the workman.

It is an axiom, that a manufacturer who becomes wealthy or too confident in his own opinion, *becomes also careless.* He does not look so sharply after the style, or finish, in which his goods are sent out of the factory as he ought. While, on the other hand, a more needy, and of course a more active, competitor is looking well to his own interest; sees well to the improvement of his fabric; and thus slowly, but eventually, beats his wealthy neighbour out of the market. Men of Birmingham, you are in this position: your markets are now shared by another set of competing gun-makers; and the more are they to be feared, as they possess the requisites for

* A Friend, who has had the honour of being a Warden, thus pleasantly describes his first agreeable surprise: "Having been about a month elected to the situation, I noticed, on entering the office one morning, a number of small parcels enclosed in writing paper, neatly sealed, and addressed to the various individuals connected with the establishment; and amongst the rest, one to myself. I opened it, and found it contained £7 odd! I naturally enquired of the Book-keeper, where it came from? 'Hush,' said he, 'put it in your pocket, and say nothing about it;—it is all right,' You may believe me," says he, "I looked into the Office at the end of every month afterwards."

a keen and eager competition, namely, *steadiness, perseverance*, and *skill* to imitate, as the boy does his master, until he excels him.

Fellow townsmen, you have been sleeping in fancied security, dreaming that no people could make guns *so well, so good* or *so cheap*, as Birmingham workmen! During your sleep, they have stolen from you the two first; they have left the last as worthless, perceiving it was base coin. Though got up under the shelter of an Act of Parliament, THE PROOF-COMPANY IS THE BANE OF THE GUN TRADE. It has ceased to be useful; it is now only a money-getting institution, and ought to be abolished. We will now show you how it is so pernicious to your interest.

The principal and sole cause of depreciation in the character of Birmingham gunnery, arises from carelessness or wilful mismanagement—*on the part of the Company*. Unfortunately, the competition of late years has been of considerable importance to Birmingham, especially in the gun trade. This trade, it is well known, is carried on by three parties,—"Gun-Makers," properly; "Gun Getters-up;" and "Factors." To these two last may be attributed a portion of the evil, next in importance only to the company. An inordinate rage for cheapness has always afflicted the *Getter-up of guns;* and the Factors, unheeding the misery they create, by reducing the workman to the lowest pittance, morally speaking rendering him a searcher after deception;—any ready method of turning out the stipulated work, sacrificing all its goodness, and retaining nothing but outside show is their aim. Thus have they, for some years, hurried on, regardless of the many cripples their avarice has made, or of how many fatherless children they have been the cause of sending to the workhouse. This is no exaggerated statement. We can prove three deaths from this alone: how many mutilations we cannot attempt to recollect;—vastly too numerous. And who are the principals in this catalogue of crimes? *The Birmingham Proof-Company.* We will prove it. They have, as before stated, become rich and heedless. No one will deny,—no, *not even a proof warden*,—that barrels are proved by thousands, which, as soon as they leave the proof house, are conveyed to the *boring mill*, and the *grinding stone, and have sizes bored out of the inside*, and *pounds ground* (i. e. *sweated*) *from the out.* There is not a gun maker who will attempt to gainsay this fact; nor is there one so foolhardy, as to say that this is not well known to the whole of the wardens;—ay, *and that some of them practise it too.* Now here is the foundation of the evil. Did the Proof Company do their duty, this could not be. The most inferior

iron, that *is to be had*, could not be used; this would be impossible. Thus we convict the Proof-Company, let them wriggle as they will.

This is not the sole extent of the evil. It is undermining your means of living—*your trade*. It is already seriously affected: a few years more if you continue in this path, the export Gun Trade of Birmingham will be matter of history. The Gun Manufacturers of Belgium are making rapid improvement while you are *retrogading*. Since the year 1835, they have extended their trade above 50 per cent. Last year, ending the 31st of December, they proved above 300,000 barrels: shewing a gradual, but a steady increase, for that term of years How stands your account? This is rather difficult to say; for the wardens of your establishment do not like the idea of publicity. Though we wrote a very polite letter requesting information, informing them we wished it for the *public good*; from some unexplained cause we have never yet received an answer: but thanks to the friend before named, *we can make a shrewd guess*. The number is considerably less than that of *Liege*. We did not last year prove more than 250,000! Thus we have the mortification to know, we are only second in quantity and *quality also*, to a nation with only half our capabilities! How is this? it may be asked. Why, simply because the people of Liege do not make guns that burst, and kill, and maim people, who use them. They have a proof house which protects them from that tendency to evil, which avarice leads bad men to. If they make gun barrels of inferior iron, the proof bursts them; they cannot *bore* and *sweat* barrels there *after proving*; because they require all barrels to undergo *two proofs*,—one in the rough, and one when the barrel is finished; therefore it must be self-evident, any undue lightening would cause the barrel to burst in its most expensive state.

We will slightly digress, and state the constitution of the Belgian Proof. The master is *nominated*, or approved by the Government. The cost of proving varies from seventeen *centimes* to eight *centimes*; the former the maximum, the latter the minimum. In English money this is less than two-pence, and one penny, or the proportion of 17-20ths of two-pence, and 8-10ths of a penny. The result is, that owing to the rapid increase of trade, the emoluments have become so large, that the manager (an excellent man) has become—to use a French expression—"*a Millionaire*," a *rich man*. As might be expected, (*and as ought to be here,*) a change has been called for by the united trade, and a commission is now sitting to determine on the reduction to be made in the cost

of proving. It is to be reduced to the lowest fraction that will leave sufficient to defray the necessary expences. And we have reason to know, that the highest price will be under *one penny!* so alive is the government to the welfare of their manufacturers.

Now contrast this with ourselves. We will tell you our mind: the writer is no political economist; but that there is something wrong "needs no ghost to tell:" with you rests the determination whether this state of things shall continue or not; whether you will continue to be filched out of £4,254 a year for nothing, and allow yourselves to be starved, or driven to seek another trade; or whether you will use some effort to throw off the incubus. We need not tell you that the Proof Company has no claim on your affections. They have not even acted up the requirements of their Act of Parliament; which distinctly states, "they shall pay the interest, and then the principal, expended in erecting the buildings; and then," *mark this*; "reduce the charge of proving to the lowest amount." Have they done so? no! They share monthly a vast sum of money, which they have no more legal claim to than the man in the moon. *We wonder they never blush!*

The Belgian gunpowder is within the merest trifle of the same price as ours: if a penny leaves a profit, what will threepence do—and in twist barrels, fivepence half-penny? it is not difficult to solve. Now if these wardens, or whatever style suits them better, had the trade of Birmingham at heart, they would reduce the price, *increase the proof*, and the manufacturer could expend the pence saved in buying better iron, the public would be the gainers.

In regard to the Belgian manufacture of Gunnery, we will merely add a few remarks. We carefully noted, from observation, first,—they have completely adopted our model and style of finish, and *apt* adepts they are; even to the common store musket they have our pattern. Secondly, and in importance it ought to be first,—*they have but two qualities of iron*. This is every thing. No shattering of hands! the commonest gun is safe,—vastly more safe than ours. This is a humiliating position, *but it is painfully true*. Thirdly, they bore their commonest guns well; *they do not send barrels away as rough in the inside as the welder left them*. They are safe, and shoot well too. They have obtained many of our best customers in South and North America especially. We ourselves saw an order, of many hundreds, packing for the Brazils, and we know they now send two, for our one, to North America. Their guns are plain, *no painting*, but sound and good; not lower in price than we sell them for. The Belgian is extremely slow at

work, to what we see in Birmingham; but then *they work from Monday morning till Saturday night; they are extremely steady.* We conversed with several, who told us wages varied from 4s. 2d. to 10s. per day, according (as here) to ability. It is evident they do not possess any great facility for making cheaper; but they make all their common guns *better.*

They are also a very tasteful people. They display great tact in discovering what will suit the different markets. We will instance an order then getting up for the Chinese, and contrast it with ours intended for the same place. They plate the barrels with a thin layer of very fine Damascus iron, (and in this they beat us hollow) on a skelp of their threepenny iron, (as good as our fourpenny). The breech, a *patent,* is ornamented with a little gold filagree work; the lock good; stock, sound walnut; carved in the hand and down the butt; ornamented tastefully, but not expensively. The whole is good and pleasing in appearance: cost, about a sovereign. Here is an article safe and sound, even handsome, suited to the taste of the peculiar people it is for.

It is scarcely necessary to recapitulate the distinguishing properties of our export to that region; they have been seen in thousands,—may be to-morrow, if required. But it can be compressed into a few words; *bad barrel* in *iron* and boring; stock and lock in keeping with the above; no glaring inconsistencies in the compound, save it be the extra pains taken to paint or *daub* what is only fit to make *park palings* of! To this use they may be applied beneficially, but to nothing better.

Now let us ask you, Who is the most likely to secure the China Trade in Guns! The Belgians.—I repeat again, Who but the Proof-Company is to blame? We cannot compliment the Government Manager on either the skill or science he has displayed in the construction of the public arms, (as we shall notice in another letter); but one thing they have done,—they have improved the proof; they have shown that good iron is all that is required, and also that it can be had to stand two proofs, for all their barrels *do* stand it. Here is an argument that *alone* shows the absolute necessity of some improvement. Fellow tradesmen, join earnestly, and petition Parliament to establish a Proof department for the whole kingdom. Show them that it will support itself, and there will be no difficulty. Put the whole of the trade on an equality; let there be but one Proof. Do not compel an artist, who wishes to make a creditable gun, to submit to the cost of time and money, in sending his barrels to London for proof. If proofs are required, let them be what they profess to be. The

Birmingham Proof-House is a bye-name throughout the kingdom.

There is yet another evil, inferior only to this, which we will shortly draw your attention to, namely, the effect the present Government arrangements have on the interests of the Gun Trade of Birmingham.

WILLIAM GREENER.

BRITISH MUSKETRY.

The following correspondence was introduced to the world by "Projectile" firing the "second shot" in the Morning Chronicle, after the gallant "Sir Charles Napier" fired the first in the House of Commons, and which we hope will be the means of eventually effecting an improvement.

Commodore Napier and the Board of Ordnance.

TO THE EDITOR OF THE MORNING CHRONICLE.

SIR—I observed with much pleasure, in your parliamentary report of the debate on Friday last, on the "supplementary ordnance estimates," that the straightforward, hard-hitting Sir Charles Napier, had opened his batteries against the fortifications of the Ordnance Board.

It really does seem plain common sense that a *naval* officer would best judge of the wants and requirements of the *naval* service; also, that such an officer should be preferred to a *military* man for supplying arms to the navy. What a sickening picture was that exhibited by the "commodore" of the defective, in fact, useless qualities of the muskets and cutlasses furnished by the board to our brave tars!—arms which he represented to be as powerless for self-defence as they are ineffective against an enemy. Considerable mirth seems to have pervaded the assembly of our legislators by the commodore's unmasking of the almost inconceivable ignorance and unpardonable negligence of the Board of Ordnance. Could his audience doubt the authenticity of the facts laid before it? These are as notorious as the bribery which has given Doctor Peel his majority in the House of Commons, and enabled him to plant Colonel Peel as the present dispenser of *(pill)* guns to the navy. The Colonel is reported to have said he considered himself quite a sufficient judge of the weapons he was chosen to administer. The writer does not

doubt that; it runs in the family of the Peels to have a complacent and self-satisfied opinion of their own qualifications—which the calm observer of their deeds is, however, apt to sum up in the single word *superficiality*. But, whether Colonel Peel's judgment of fire-arms be, or be not, equal to his own opinion of it, there can be no harm in pointing out to him the means of increasing his knowledge; for, one cannot fancy that either the late or the present Board of Ordnance would, knowingly and wilfully, supply the "right arm of Britain" with defective muskets, and cutlasses fit only for reaping-hooks. Let me, for our common country's welfare, invite Colonel Peel, and the associates with whom he, *pro tempore*, divides the heavy responsibility of his department, to look to the quality of the drugs in their dispensary, to purify it of the "perilous stuff" it has so long and so culpably disseminated.

It was stated that the muskets issued to the navy bore the "Tower mark" upon them. Granted; but that *mark* does not constitute the shooting quality of a gun, any more than the saddle denotes the paces of a horse! Is the British musket such as it ought to be?—that is the question. Let us hear what a recent impartial and scientific author, who appears to be equally experienced in the arts of manufacturing and using fire arms, says on the subject:—

"The length of the latest pattern musket is three feet six inches in the barrel—a uselessness of length, except as a pike; for, as I have before said, the windage so destroys and neutralises the force of the ball as to render it, as it is, a most imperfert arm. No need to tell me they are as good as those of other European nations (which I know they are not), for this is no reason, but a very lame one indeed, and as such, quite untenable. England *can* make, if she *would*. But 'there is something rotten in the state of Denmark.' *Was more attention paid to arms war would not endure so long.*

"Percussion muskets are now in manufacture for the whole of the service; several regiments have them in use The Guards took them to Canada, and, report says, *had no caps*. There have not been many entirely new ones made; but a bungling method has been adopted of brazing a piece with hard solder on to the side of the old barrel, similar to the piece welded on to the side of a sham damn gun, into which the nipple is inserted," &c., &c.

After treating of an admirable improvement in the rifle bullet, *which was laid on the shelf* by the Board of Ordnance, the author says, "Thus it is, and ever will be, I fear, in England. A plan in advance of the age is treated as chimerical—as the emanation of a distempered brain, and as such, untenable.

From causes like these, England's talented officers and brave men are invariably worse equipped, and less taught. That which is of most consequence is treated as of the most trifling importance."

On the subject of the military rifle in use, the author observes :—

"The idea of a body of riflemen armed with this peculiarly-constructed gun (two-grooved rifle) is absurd, and shows how matters are conducted in first-rate states; the name may inspire terror, but I have been acquainted with rifle corps, the individuals of which know as much about the use of a rifle as a theodolite. Ask them a question at what range they can shoot? 'Oh,' will say a knowing old sergeant, 'a musket will kill a mile, but our rifles exceed that considerably; we practise from 500 to 1,000 yards,' and all such twaddle as this. Arms are put into men's hands, and that is all; as for any instruction, it is quite out of the question; learn what you can, and God speed you; neither officers nor men are ever taught to use their rifles. I have seen companies at ball practise, where the officer says, 'What the deuce are you about, *Sergeant Target?* you have been near half an hour longer in firing than No. 8 company was; be quick, sir!' What folly to give arms at all, without instruction! but how much greater to give rifles, and no practice at sufficient ranges. A *well-constructed* musket is perfectly capable of projecting balls, too, with truth.

"How contemptible a weapon is the musket that actually requires men to stand at targets for the artillery, though not at a greater distance than 500 yards! for the soldier cannot use it, from the certain knowledge it will not range half the distance. How powerfully destructive it might be at that distance, if arranged with moderate attention to either science or skill! It is ever a cry that soldiers are such a stupid race of men, you must have every thing of the simplest description possible, or they cannot use it, or such an arrangement would interfere with the *evolutions*, a matter which is, unfortunately, considered of the first importance by our *martinets;* it matters not the superiority of injuring an enemy at a distance where he cannot annoy you; no, the personal safety of the soldier is never cared for, it would lessen his *bull dog* courage; so you must place him within 100 yards of an enemy. Fire-arms ought to have effected much greater changes than they have done, and unquestionably they would, had they been managed with even moderate skill; but, all the efforts have been directed to the leviathan class, and, no doubt, here a vast improvement has been effected."

The author pays well-merited compliments to Sir Howard Douglas, for his advocacy of the advantage of instruction in

naval gunnery, and to Sir Thomas Hastings for his arrangements appropriated for that purpose on board the Excellent at Portsmouth. He strongly urges the extension of a similar *practical education* to the military service in small arms.

The above extracts are taken from a work entitled the "Science of Gunnery," by Mr. Wm. Greener, gunmaker, of Newcastle-on-Tyne, which it will be seen fully bear out the statements of Sir Charles Napier.

I am, sir, respectfully your's,
PROJECTILE.

No. I.

TO THE EDITOR OF THE TIMES.

Sir,—The late unfortunate national loss, by the conflagration of the small-arms depôt at the Tower, leaves an opening for some remarks on the construction of the British musket, as it is a matter of certainty that the arms destroyed must be replaced. I may therefore be pardoned if I point out the glaringly unscientific principles on which all our present stock is fabricated, and also a few suggestions for future improvement. To those versed in gunnery, it has been for many years a source of regret that our brave troops are sent into the field worse armed than those of any other nation in Europe; and it would be unpardonable did the present occasion pass without some attempt to remedy the evil. Few persons are aware of the distance to which our muskets will throw the average of their balls; more will be astonished when I tell them that if the musket be fired in a perfectly horizontal position, the ball never ranges beyond 130 yards. The experiment may easily be tried by fixing a musket on two rests five feet above the earth, then inserting a spirit level into the muzzle of the gun, to obtain a true horizontal line, and firing twenty rounds. The average of the balls will strike the earth at 130 yards, having thus fallen during this short flight five feet, while to enable the same musket to range 200 yards, it is necessary to give an elevation equal to fifteen feet; and in short scarcely any elevation is sufficient to project a ball 300 yards, so extremely inefficient are they. It will be, indeed, like "sleeping on our arms" if we imagine these rude machines sufficient to contend with any European nation at the present moment. We are decidedly in the rear as regards the scientific construction (the workmanship, I believe, is better), and why should we not excel in principle as much as in workmanship? We have sufficient talent in England to compass it, and it is an easy task, if we look the difficulty fairly in the face. We should lead the improvement, not wait until it becomes madness to do so any longer, but "advance one vast march in science,"

until our arms are, like the hearts of our men, the best in the world.

The inferiority of the British musket arises from three causes—first, from being of too large a bore; secondly, from having an excess of windage; thirdly, from being too heavy, and thus too clumsy. These three defects render and prove the whole construction bad, and based on unscientific principles.

The proper intention of musketry is, that the gun shall throw a ball to the greatest possible distance in a horizontal direction, so that the height or altitude of the flight of the ball shall never exceed a certain distance from the earth. For instance, from the height of a dragoon on horseback, the present weight of ball, 1.06 ounces, can never be driven in a horizontal direction, for a velocity equal to it cannot be obtained without using so great a charge of powder that the recoil would lame the man, or break the piece, and hence the reduction of charge adopted in the new detonating plan (and not caused, as reported, by the percussion alone). Great weights offer greater resistance both from their inertness and the increased volume of air contained in the tube. A ball the eighteenth part of a pound, or 645 inch. in diameter, can be projected 1,000 yards with four drachms of powder; an ounce ball requires nine drachms to do it, and is attended with an excessive increase of recoil. A 24 lb. shot can be only projected 1,850 yards with 8 lb. of powder, and in addition requires more than three times the elevation; therefore, it is not true in practice, whatever it may be in theory, "that the greater the weight the greater the momentum." I would rather have greater velocity, for, in having it, I have a range, and having range, I insure a more horizontal fire. The French use a ball .65 inch in diameter, a size unquestionably calculated to do greater execution than our own, and at a greater distance. Secondly, as regards excess of windage, this is of the most serious import. The windage of the English musket is the difference between .75 inch bore and .676 inch ball; or, in common parlance used in gun-making, making five sides, the bore being 11, the ball 16, while the French windage is .69 to .65, a very material difference indeed. The general argument adopted is, "windage is required to enable the soldier in action to load quick." The French practice is a sufficient answer to this assertion, for no one has contended that they do not load as quick as our men. It is an error to suppose that any thing is gained by this great disparity of size, for when a ball fits moderately tight it partially cleanses the tube during every explosion, and a greater number of shots can be beneficially fired with a tight than with a slack ball, which never disturbs the deposit. It is a law in science, that no correct motion can be

given from an incorrect source, nor can a ball be driven straight out of the gun-barrel unless it accurately fits the tube, for the first motion forward, also produces a lateral motion, the lateral motion a number of accelerative rebounds, which eventually end in the ball obtaining a zig-zag motion, influencing both its direction and its range. The impossibility of steam moving the piston in an engine cylinder without the piston is tightly packed is well known and must be quite apparent. If the ball in the musket be too small, the explosive matter escapes between the ball and the tube, and expanding in front offers, together with the column of air, a resistance proportionate to its quantity, for we must be quite aware that the velocity of expansion of gunpowder is vastly greater than the velocity which can be communicated to any ball; therefore it is no stretch of imagination to say, that the range of the ball from a British musket is not one-third what it ought to be, and might be, under even limited alterations. Those best able to judge will agree with me, that a ball of eighteen to the pound will range, if no windage is allowed to exist, to three times the distance to which our musket, as at present constructed, will project it. Now, this is what is required in warfare. That weight is equal to anything wanted, and it will penetrate deeper from an increased velocity. I need but instance the construction of the altered muskets—the pretended new ones with which some of our regiments have lately been furnished. It has been found necessary to place a sight on the barrel, six or seven inches from the breech, and 3-8ths of an inch high, which, added to the thickness of the barrel, gives an elevation to the tube, after deducting the thickness of the muzzle, of near 5-8ths of an inch in 33 inches, or 3 feet 5 inches in 100 yards, which is about the actual elevation required to throw the ball 300 yards, with a well constructed gun. Here we have, in fact, no point blank range whatever, or at most not exceeding 20 yards. Need I say more? the matter must be plain to all. Then, again, are we to suffer our men to be targets for an enemy at a distance at which our muskets are comparatively harmless? A good musket is nearly equal in range to a six-pounder, and would teach an enemy's artillerymen the necessity of keeping respectful distances. But all attention has hitherto been paid to the leviathan class of guns; the small-arms are forgotten. Let us not forget that the Emperor of Russia has now manufacturing at Liege, 15,000 stand of arms, calculated to be effective, at or near 1,000 paces! What comparison will ours bear with them? I have to-day witnessed the ball practice of the 61st regiment with the new musket, the distance nearly 90 yards, and the average number of shots striking the usual military target 2-5ths, a most contemptible

result, nor will it be otherwise with the weapon as at present constructed.

3. The weight is too great, a contingence depending on the size of the bore. The present weight is 11.91 lb., that of the French musket 10.98 lb , and the latter is fastened to the stock by brass bands round the barrel. If the bolt used by us were adopted, they would then have a musket 2 lb. lighter than ours, a matter of great importance. No infantry in the world are so encumbered as ours, for, in truth, every part of their accoutrements is of the rudest and most clumsy description, which adds materially to the weight carried. A gun possessing all the power, in fact, much more than the musket of the present day, may be constructed not to exceed 9 lb.. The present bore necessitates an increased weight of barrel ; this, a corresponding bulk in the stock ; and hence the present unwieldy, unsightly, and inefficient arm.

With the above remarks, I shall leave this part of the subject, premising, that I shall shortly have a few remarks to offer on the mechanical construction of muskets.

I am, Sir, your very humble servant,

WILLIAM GREENER.

Newcastle-upon-Tyne, Nov. 8, 1841.

No. II.

TO THE EDITOR OF THE TIMES.

Sir,—Colonel Mitchell attributes (as most military men do) all the defects of the musket to the cupidity of the contractors, though another writer in your journal very justly lays the *onus* on other shoulders, by gently insinuating that the authorities to whom is delegated the responsible duty of directing the manufacture of our national weapons "are not practical men." Most cordially do I join with him in this opinion, and unhesitatingly assert they are not : and, being such, are quite unfitted to wield this high and important trust—a trust involving the honour and invulnerability of Britain. They are unquestionably men of the highest ability as officers, as brave and gallant soldiers—but they are not skilled in mechanics. Their portion of science is applied to other subjects than a study of the principles that ought to be embodied in such national weapons as the musket, carbine, and rifle.

The defects in the mechanical structure of the musket are numerous. The one of the greatest consequence is the continuance of the common plug in preference to the conical or patent breech in the construction of the percussion musket. It must be quite apparent, even to those the least read in the science of gunnery, that on the explosion of gunpowder, its

action is equal in all directions, but divided, in certain proportions, upon the ball to be projected, on the breech resisting, and on the sides of the tube. Now, if the area of the flat even surface of the plug or breech be greater than the area exposed by the ball, a force proportionately greater acts upon the breech, the breech upon the stock, and the latter upon the shoulder of the soldier; and hence it happens that a force, at least amounting to 25 per cent. upon the whole, is lost in the projection of the ball. The angular or conical form of the patent breech opposes no direct surface to the action of the exploded fluid and consequently the recoil is trifling, being at least 50 per cent. less than with the common breech. The force is thus more beneficially exerted in expelling the projectile—a matter of safety as well as economy.

It has been said that the adoption of the conical breech does not aid the range of the musket at all. This is true, and it is accounted for by the windage, for the existence of it necessitates the employment of an excess of explosive matter; the excess of explosive matter causes an immense escape of fluid by the windage; and this expanding before the projectile, rules the ratio of velocity. Double the present charge of powder would neither increase the accuracy nor the range of the shot, proving the present arrangement to be the most wasteful and ill-judged of any in practice in Europe at the present period. Gunpowder to be beneficial must be concentrated or guided in its action to that extent only to which it is advantageous; a step beyond this produces the reverse of what is expected.

A most imperfect system has been adopted in the alteration of the old muskets, namely, the brazing on to the side of the barrel a piece of iron for the insertion of the nipple, which communicates ignition to the charge by a small perforation into the side of the tube. The party who recommended this for adoption in the army will, I hope, lay no claim to the possession of either scientific or mechanical knowledge. He ought to have known that soldering pieces of iron together, by either spelter or brass, is only a local attachment, liable and sure to be destroyed by the galvanic and chymical action produced by the gases generated, first by the explosion of the fulminating compound, and secondly, by the gunpowder; all made still more active in their effects by the water requisite to cleanse the barrel. This conclusion I formed 12 months ago, and this very day I found it my conscientious duty to recommend the condemning of six muskets belonging to the 61st Regiment, in which these brazed pieces have given way from the effects of only the second annual ball practice to which they have been subjected. Water finds its way through the brazing by simply

blowing into the barrel. One of these pieces blew off during the practice last year, and splintered the stock in rear of the breech severely, with considerable danger to the soldier. The gentlemen in the small arm department may possibly overrule my opinion, but it is formed after a most patient study of the responsibility attached to the conclusion. And I am further convinced, that five years of active service will wear out the majority of muskets so altered—a fit result for such "cheese-paring economy;" for the cost between such alterations and new barrels would not have been more than 4s. each; in fact, a difference of about 6s. or 7s. at most would have furnished such a barrel, with patent breech added.

The introduction of the plan of rolling barrels by machinery instead of welding by hand, has been productive of considerable deterioration in the quality and strength of the musket barrel, for no compression will ever condense the iron in a barrel to the same extent as beating by hammers. And in this conclusion I am backed by the fact that the 98th Regiment had six barrels burst during sixteen months up to the last year—a result which would not have occurred save from the above system of manufacture. But twisted barrels can be produced in Birmingham, of undeniable quality, for 12s. each. Under such circumstances, what valid reason can be given for their non-adoption? It will, I think, scarcely be denied that both safety and durability would be gained by it.

The locks, too, are of a piece with the whole construction, being only fit for guns suited to the African market. The beautiful principles developed in the construction of the English fowling-piece lock are deservedly the admiration of the world; to that of the musket is due its contempt.

The intention of the tumbler of the former, when aided by the swivel or crank, is to give an arrangement of leverage, partaking of the multiplicate; for the weight, when approaching full cock, is lessened by the lever bringing the moving force into the immediate vicinity of the axle of the tumbler, and when down on the nipple, increasing or multiplying that force by the divergence from the axle. A well-made swivel lock shows only half the weight at full cock that it does when down on the nipple. The present musket lock is formed upon the old (and save in this instance) obsolete plan of the hook tumbler, where the end of the mainspring is required to travel up an incline on cocking, and down in firing, and thus the extent of leverage cannot be obtained to more than at most one half of the fowling-piece lock. To obviate this, it is requisite to use a main-spring, which at first lifting is equal to 25lb. The friction caused by this arrangement, during an absence of oil or grease, is im-

mense. A musket was taken promiscuously to-day, and on the balance being applied, 30lb. were requisite to lift the cock from the nipple, while the true strength of the main-spring was only 22lb., 5lb. held it at full cock, and the true force was 14lb. The per centage of strength destroyed here by friction any one may calculate. The amount of friction under any circumstances in a swivel lock can never exceed one per cent. Any person acquainted with the nature of percussion must clearly see that a musket lock on this principle, requiring oil constantly, is strictly useless, for where can a soldier seek oil in an engagement? The idea is the height of folly. An excellent swivel lock, much better than any musket lock in the service, can be made in Birmingham for the low price of 6s. 6d. each. Comment is useless. The average strength of the present main-springs is 24lb., the pull of the trigger 10lb.;—one excellent reason for a soldier never being a good shot.

A few words more as to the weight. The present barrel weighs 4lb. 11¼ oz., a reduction in the bore would admit of a reduction equal to the odd 11¼ oz. The lock is 12¼ oz., this might beneficially be reduced to 8 oz. The stock and bayonet is 6lb. 5 oz., and would be decidedly improved if reduced to 4lb. 5 oz., making a total reduction of 3lb., and leaving the musket in round numbers 9lb.: heavy enough, and sufficiently strong for every purpose required. The cost of some of the entirely new muskets which have been got up for the Guards, I believe, is certainly great, amounting to 90s. each. But this cost has been created entirely from a mistaken notion of dressing "the crow in peacock's feathers," fitting up a barrel and lock of the most inferior quality with a stock that in point of workmanship would not disgrace a 30 guinea gun, thus frittering away money—a pretty conclusive proof that there is an inefficiency somewhere. A much superior musket can be furnished, with twisted and patent breeched barrel, swivel lock, and in every respect as sound and serviceable, for 60s. each.

I would recommend the authorities to offer a premium for the most useful, sufficient, and cheap arm. If they do this, they will do well. I am, Sir, yours truly,

WILLIAM GREENER.

No. III.

To the Editor of "The Times."

Sir,—Your correspondent, Lieutenant Gordon, alludes to an error into which he supposes me to have fallen, respecting the diameter of the musket-ball. The diameter of the ball, sixteen to the pound, is .671 inch. The diameter of the present musket-ball, twenty-nine balls weighing 2lb. is .676 inch; there-

fore, had I used the word "nearly," it would probably have saved me the trouble of mentioning the matter again. The discrepancy is explained by the fact, that all gauges are formed from cast balls: the government, at present, press them by machinery, and thus a heavier ball, though not greater in diameter, is produced.

The progress of the art of gunnery, as regards improvement by nations, has hitherto been divided into eras; for states do not advance in science gradually and steadily like individuals, but, having made one step forward, they generally halt until knowledge has got so far ahead of them, that it becomes actually necessary that they should, by forced marches, endeavour to overtake it. This accomplished, they pile arms again, and rest in imagined security until a recurrence of the disparity ensues. Just so is the case with the management of the *materiel* of war by this great nation.

To Robins we owe the first era of improvement, for, unquestionably, he added largely to our store of knowledge on projectile force, and laid the broad and solid foundation on which Hutton built himself a monument of fame, by extending the principles discovered by Robins. This was the second era. Hutton, however, like most philosophers, drew his deductions entirely or chiefly from theory, and erroneously asserted them to be so correct as to defy contradiction, and to be beyond refutation. The consequence of this has been, a stoppage to all further improvement since his time, and the deductions of the mathematician have thus far been received as laws unalterable as those of the Medes and Persians. One great error into which Hutton fell, and one which rendered all his conclusions unsound, arose from his limited experiments, and his want of practical knowledge. The whole round of his experiments was conducted with guns suspended as pendulums, and the distance to which the recoil extended the gun on the arc, was the datum from which he calculated his principles of the expansion of gunpowder, and the projection of bodies. Nothing can be more fallacious than the doctrine laid down in the following quotation:—"The weight of the gun produced no change in the velocity of the ball. The guns were suspended in the same manner as the pendulous clocks, and additional weights were attached to the pieces so as to restrain the recoil; but although the arc of the recoil was thus shortened, yet the velocity of the ball was not altered by it. The recoil was then entirely prevented, but the velocity remained the same."

It is a truism that action and reaction are equal; for elastic force exerted upon any thing unsound is nevertheless consumed; but if resisted firmly in one direction, that force becomes bene-

ficially exerted in another direction. Gunpowder exploded in a gun firmly resisting, gives to the body to be moved its whole power; but if the gun be moved at the same instant, the projectile receives only its modicum of force, the whole force being divided into two portions, and expended in opposite directions. A knowledge of this fact is, in a national point of view, of immense advantage if acted upon, for we may either obtain the same results with half the means, or double them with the present. And here we are again in the back ground; here again becomes apparent the want of combination between practical and theoretical science.

A clear perception of these truths enables us to define the correct shape of guns, for there cannot be any doubt, that by a most scientific arrangement of even the present weight of metal, a considerable improvement in the projectile power of guns would be obtained. Recoil produces in metal a series of vibrations, and by lengthening their duration a corresponding advantage would result, for where there is a sufficiency of metal, and judiciously placed, little movement can take place until the ball has left the bounds of the gun.

This theory Hutton never studied, or he would have hesitated ere he stated that no advantage was obtained by "retarding the recoil of the gun;" forgetting that, in the recoil of a gun, it matters little whether she be stopped at six feet or one inch; for, if movement takes place, be it ever so little, during an explosion, the force is as effectually destroyed and as useless as if never generated.

Hutton's next great error was in concluding that only a certain amount of force could be obtained from a certain quantity of gunpowder. Sir Humphrey Davy discovered that the force of gunpowder was increased by granulating it as finely as possible; because, in this state, its explosion on his glass plate was nearly instantaneous. Davy was unskilled in the practice of gunnery, or he would have perceived that this very quality unfitted gunpowder to be a projectile force, which to be really efficacious must be not only highly expansive, but have the faculty of retaining the highest state of expansion until the projectile has reached the muzzle of the gun. If the force is expended too soon, and the concurrent conditions are not fulfilled, the velocity obtained would be less than in the former case.

Thus, these two philosophers obtained two results: Hutton, that only a certain quantity of powder could be consumed in a barrel in a certain time; Davy, that the more quickly it is burnt the better. Neither of these hypotheses are practically correct, for the grand secret in projectile-force consists in a mo-

dification of the granulation between the two extremes, in order to suit every or any piece of gunnery yet manufactured.

The excessive windage allowed in artillery practice is quite as detrimental to the obtaining accuracy and range, as is the case in the musket adverted to in my last letter. A waste of gunpowder to an immense extent is the result, without any corresponding advantages being realized. Brass ordnance is rapidly destroyed from this cause alone; for, after firing four hundred rounds, the zigzag motion of the ball in a perpendicular direction, converts the cylinder of the gun into an oval, and the cannon becomes useless—a waste of money that cannot be defended upon any principle I am aware of. The French have adopted a less ratio of windage, with the greatest success, and it is to be hoped that the present Government will see the necessity of a revision of this matter.

One favourite suggestion of Hutton's has hitherto been strenuously rejected, even by those to whom his recommendations have, in other respects, been laws—viz., his plan of using "oblong bullets." Some years ago I laid before the Board of Ordnance a very simple plan of getting rid of all windage, yet of wadding easily, and adding to the weight of the projectile (a favourite theory with the artillerists). This was effected by employing an oblong ball of lead a diameter and a half in length, having a perforation extending through two-thirds of it. An iron plug of a conical shape is slightly inserted into this perforation, and the gun loaded with it. When the explosion takes place, this plug is driven home into the lead, and, by expanding its outer surface, the projectile comes out of the gun fitting as tight as possible, and a line of flight is given to it of corresponding accuracy. The advantages of this arrangement are numerous, but, in naval warfare, of the most important nature, giving heavier metal with smaller rates, and from the composition and shape of the projectile combined, producing a corresponding destruction.

But the authorities laid the plan upon the shelf, where it will rest until produced by some more important personage than myself. The poor inventor obtains but poor encouragement; while his more wealthy competitor is enabled to have every opportunity of trying schemes which, in most cases, are not worth the consideration of any, save the friends of the party. One recent instance of this is to be found in the muskets lately distributed to the infantry regiments to try, and be reported upon. To adopt them would occasion a complete change in the usual manipulations, and this without any definite advantage to counterbalance the evil.

The whole utility of the arm is dependant upon the repair

of one screw, while the stock and other arrangements of the gun are weakened, and rendered inefficient, by the alteration.

I am, Sir, yours very truly,

Newcastle, Dec. 20, 1841. WM. GREENER.

No. IV.

TO THE EDITOR OF THE TIMES.

SIR,—The muskets referred to in a former letter, which have proved defective in the 61st regiment, have been ordered back to the Tower; and here I should have let the matter rest, had not the order for their removal been accompanied with remarks which appear to me calculated to impede improvement, and to exhibit a further proof that the parties in charge are really not aware of the defects arising out of the present plan of brazing side pieces to the barrels. The deficiency is attributed to the "faults of a contractor, who has since failed." It would be as sensible to make a journeyman stocker liable for the blame of a stock breaking after eighteen months' service. No, the error lies with those who planned such an alteration, which, being faulty in its nature, must necessarily turn out bad in service. In addition to my former remarks I may add, what every mechanic will understand, that a space of above an inch square has to be joined by fluxing brass, or spelter, the first action of the fluid being when directed by the flux (borax) to run round the outer edges of the joint, and, consequently, the air in the interior becomes expanded and confined, and prevents the melted brass from finding its way there. Thus an imperfect junction of the metals is effected in nine cases out of ten. And again, in tapping the hole for the reception of the nipple, which is inserted partly into the barrel, and partly into the brazed piece, a force is required to form the thread of the screw sufficient to disturb the imperfect junction, and thus the first defect is made worse by the second. When it is considered that the force of a main spring of 24 lb. weight, and acting with a velocity of 500 feet per second, strikes the nipple inserted between two partially adhering bodies, how long, or how many blows the job will bear is easily guessed at. It needs no seer to prognosticate that two active campaigns would reduce them to what they are at present, fit only for old iron. The defenders of this system must remember, that except in ball practice, or blank firing, these percussion locks have never been snapped as flint locks are in drill, but have been kept *in lavender*.. I suppose

this happens because nothing has yet been found to lessen the blow on the nipple, and thus prevent the jar from breaking it; no cushion can be formed of the requisite softness and elasticity to save it.

The fire at the Tower has of course destroyed the majority of the muskets left to be so altered; but not another penny ought to be thus spent. This cobbling of percussion guns urgently demands the direct interference of the enlightened Master of the Ordnance, and through him, of the heads of the government if needs be; for, depend upon it, a perseverance in this system will bring great discredit on our arms. On the score of a saving of expense it is "penny wise and pound foolish."

Another unscientific arrangement of the last two years is the manufacture for the army of the two-groved rifle, an invention bearing date as early as 1646. The acumen of our ancestors was sufficiently keen, even at that early period, to perceive the defects of this gun, and as soon to discard it, as unfit for even their generation...... Novelty is the ruling passion of many men, more especially if it be advanced with a specious gilded specification of many apparent advantages, and a careful concealment of defects. The advocates of this novelty—this two-groved rifle—lose sight of one most essential point. Dr. Ure says, "The intention of all rifles is to impart to the ball a rotatory motion round its axis, as it passes out of the barrel," &c.; and after a lengthened description of loading he thus proceeds:—"But instead of this laborious and insecure process, the barrel being now cut with only two opposite grooves, and the ball being framed with a projecting belt or zone round its equator, of the same form as the two grooves, it enters so easily into their hollows that little or no force is required to put it down upon the powder, yet, so much more hold of the barrel is at the same time obtained, that instead of one quarter of a turn, which was the utmost that could safely be given in the old way without danger of stripping the ball, a whole turn in its length can be given to the two-grooved rifles. The result is, that better practice has been performed at 300 yards than with the best old military rifles at 150 yards; and it is, when skillfully used, of unerring aim even at the prodigious distance of 700 yards." Now it is such palpable mystification as this that leads astray unpractical men, and enables a schemer to obtain a footing for, at best, very doubtful plans. The matter stands thus: there was in reality no rifle in the British service; for what individual would for a moment maintain that a quarter of a turn in their length (2 feet 9 inches) constitutes a spiral

at all, since it can but thus cause a ball to turn on its own axis once in every 11 feet during its flight? There is no sufficient spiral motion to counteract the contending influence; therefore, it is very easy for Dr. Ure to say the other excels them at double the distance. The one certainly approaches nearer to what a rifle ought to be than the other, which is no rifle at all, but a barrel grooved in seven places, and those equal in space or area to the projections. The defects of the two-grooved are two-fold—first, the excessive spiral (a turn and a quarter in 2 feet 9 inches long) creates an immense degree of friction in the barrel; secondly, the projections upon the ball create such a "sawing upon the air" as to change the axis of a spiral motion from that coincident with the line of flight to an axis perpendicular to, or the reverse of, that intended. This extreme spinning motion is obtained at a sacrifice of velocity, force and range; for what is the fact? Why, that instead of a weapon "of unerring aim at 700 yards," it will only range at that distance.—So much for puff! Now, a well-made rifle, under the same circumstances will range above 900 yards, or 25 per cent. further than this abortion of science; and because we had formerly very imperfect arms we are now to be content with any, if they but excel the old. I contend that national weapons should be the most perfect that can be produced, and not be adopted because they are the greatest novelty of the day.

Those acquainted with gun-makers know them to be a scheming race, always discovering some great improvement, even though they dig up what has been interred for years. I would, however, suggest to the government, that rifles are at best but weapons of doubtful excellence. I may truly say, I have tried more experiments than most individuals of the present day, and have ever found that the supposed advantages of the rifle exist more in imagination than in reality. A well constructed cylindrically bored barrel will project a ball further than the best rifle under the same circumstances fully 100 yards further, and that with only a very trifling addition of elevation. The disadvantages of the rifle, as a military arm, are very numerous, and it can only become useful in the hands of a man well skilled in its use; and it is for this reason, unfit to be put into the hands of a body of men of indiscriminate ability. So convinced am I of this, that I would undertake to teach any number of men, taken promiscuously from a regiment, to contend, with a well-constructed musket, against any similar number armed with the best made rifle yet produced, quickness and accuracy combined. Therefore I think it behoves any government to study well the subject before more rifles are

manufactured, for they at all times involve a considerable increase of cost.

The carbines used by the cavalry partake of all the defects existing in the musket, and are totally unfit to be fired from horseback, their recoil is so excessive. I shall dismiss this portion of my subject by remarking, that if it is not thought requisite to reduce the bore of the musket it is imperative to reduce the bore of the carbine, for its range is of the most contemptible description, arising both from the windage and the recoil. A carbine of half the weight may be made to project a ball three times the distance if attention be paid to its scientific construction. I shall, Sir, being myself a shot, shortly offer, with your leave, some remarks on the mode of instruction adopted in the army, to give a recruit the ability to become a shot.

I remain, Sir, yours truly,

W. GREENER.

Newcastle-upon-Tyne, Dec. 22, 1841.

THE TWO-GROOVED RIFLE.

TO THE EDITOR OF THE TIMES.

Sir,—Your correspondent, Captain Groves, is enamoured of the beauties of the two-grooved rifle, for he observes, "as regards the old rifle I am not going beyond the mark in saying, that better practice is made with the two-grooved at 250 yards than with the former at 200," or 20 per cent. better. I have already shown that the old rifle was very defective, and this, I think, Captain Groves will not dispute. Dr. Ure is still more lavish in praise of this "abortion of science," for he states the superiority of the two-grooved rifle at 100 per cent. The intention of all rifling is to give to the ball a spinning motion on its axis, so that all parts of the half-sphere of the ball shall be opposed in rotation to the friction of the atmosphere, and in doing this the spinning motion must be proportionate to the velocity given to the projectile; for, unquestionably, an extreme spiral motion, with a high velocity, is as injurious as the reverse; and here it is that the defectiveness of the two-grooved rifle appears. The purport of all military and small arms is to throw a ball to the greatest possible distance in a direction as nearly horizontal as can be attained; for if elevation be re-

quired, no object can be struck midway in its flight, the altitude or arc of the ball in its passage through the air being so far above the earth as to pass over the heads of the tallest dragoons on horseback. Such is the fact with these rifle balls. Captain Groves lets the secret out, for he says, " at 400 yards" (a range hitherto never thought of in practice) " the two-grooved rifle would put 16 out of twenty balls into a 6-feet target, whilst those from other rifles were nowhere; and be it remembered these results were effected with a charge of powder of 2½ drams only to a ball of 13 to the pound, whilst the charge of the old rifle was 4 drams, and the ball 20 to the pound." The extreme spiral of the two-grooved with this charge would certainly cause the ball to fly more evenly than the imperfect fitting ball in the old rifle, where there is no beneficial spiral, and where the escape of the explosive matter by the grooves was neutralizing the explosive force behind. But what, in reality, is the result of the practice with these rifles, with a charge of four drams? In general, they throw their balls " nowhere," and this, too, with a full share of recoil to the user. Every rifle shooter knows that by elevation, and a small charge, considerable accuracy can be obtained; but a soldier cannot apportion his charge to suit the range; he wants an arm efficient at all moderate distances; he is not to become a proficient in mortar practice; and what better is the two-grooved rifle shooting at 400 yards? I know from experience that it requires an arc of altitude nearly 30 feet high to make a ball range that distance; whilst at 700 yards an elevation little short of 45 degrees is necessary with the former charge. A well made rifle, fixed immoveably, will project 19 out of 20 balls into a circle of 18 inches in diameter at 300 yards. A two-grooved rifle will not do more, and, in doing so, requires a great increase of elevation. Then, whence the advantage? is there any? I say none. I know not what rifles by London makers competed against them in the trials, I saw a portion of them, and, though the result bespeaks their inferiority, I know that if both descriptions of rifles were confined to a charge of four drams, the two-grooved would be found the worst; and if the range were increased to 800 yards, with the same quantity of powder, I would engage to fabricate a plain cylindrical barrelled gun, which shall beat both specimens, it being impossible, with a high velocity, that grooved barrels can be beneficial.

I am, Sir, your obedient servant,

WILLIAM GREENER.

Newcastle-upon-Tyne, Jan. 7, 1842.

TO THE EDITOR OF THE NAVAL AND MILITARY GAZETTE.

Sir,—I have read with care and attention a letter in your paper of the 1st, from Colonel Leach, on the subject of our arms, and also the observations from Mr. Greener; on these documents I will venture to offer some remarks.

In respect to the weight of the musket, there can be no doubt that if, without reducing its efficiency the weight could be reduced, it would be desirable; but it is impossible not to see that the reduction proposed by Colonel Leach must inevitably tend to diminish the power of the arm. It might as well be said that a six-pounder is as effective an arm as a nine-pounder, as that the musket of Colonel Leach is equal to the new pattern arm now issued to the regiments of the line. In that arm several very important reductions in weight have been made, and I am persuaded it is as light as possibly it can be constructed if we are to continue to use the present ball, which, whatever Colonel Leach or Mr. Greener may say, itis the opinion of the highest military authorities we should do.

I quite agree with Colonel Leach in thinking that a green coat does not make a man a good shot, and every riflemen ought to be perfect master of his arm. Entertaining this opinion, I have long thought that it would be very desirable that in each regiment of Infantry the men, say ten or twelve in each company, who are really the best shots, should be armed with rifles, and either formed into one company, as are the Light Infantry at present, or else distributed through all the companies, as may be deemed best. By this means every regiment going on service would at once carry with it its proportion of riflemen. At this moment a service is required from our troops, in which I consider such a system would have been found highly advantageous. I cannot conceive any occasion in which a body of well-selected good shots might have been of greater use than when employed against the Chinese, where the great disparity in point of numbers can only be compensated by superior discipline and efficiency.

I agree with Colonel Leach entirely in all that he has said in regard to target practice. Every opportunity should be afforded to our soldiers to become expert shots. Every man should be fully aware of the power and effect of his arm at all distances, from 60 to 600 yards, and even more; and every man should be practised in firing at a target until he felt pretty sure of hitting a man once in two or three times at

100 or 150 yards, and of firing into a column at any distance within 500 yards. Measures, therefore, should be taken to enable our soldiers to acquire the utmost proficiency in the use of their arms. It would give them a degree of confidence that would be found of the utmost possible advantage in the hour of need: and, entertaining these views, I fully concur with Colonel Leach in opinion that this is a subject "second to none in importance."

In the observations of Mr. Greener I find much to show that he is a man of some science; but as it often happens with scientific men, it appears to me that his notions partake somewhat of the faults he attributes to Hutton and to Davy, that in fact they are a little more theoretical than practical. The merits or demerits of his oblong ball I will not pretend to discuss—but, on the face of his proposal I confess it does seem, even if his principles are correct, that it is not altogether applicable to service. If he means the oblong ball with the new plug to be fired from a musket, I would ask whether it is reasonable to suppose ammunition of this description could be made up for the whole army? or if this were practicable, whether the increased power—supposing even there is an increase of power—would be worth the increased expense? If Mr. Greener means to use the oblong ball in our field pieces, or still heavier guns, I would then ask him whether he has ever calculated the enormous sum of money it would require to provide a supply of lead for such an object? whether lead would be as efficient as iron? and whether he is prepared to sacrifice all the iron shot at present in store? and this, I suppose, he must mean from his complaining of their effect on the bore, in consequence of the windage which Mr. Greener must be aware has already been reduced as much as possible, consistently with the use of iron as a projectile.

Mr. Greener objects to some muskets that have recently been distributed to be reported upon. I cannot discover from his description what is the construction of these muskets; but if they are liable to the objections stated, I conclude the reports will say so. I presume Mr. Greener does not blame the Ordnance or the Horse Guards (I infer the muskets he speaks of have been issued from one of these departments) for submitting to trial such new arms as it may appear to them are worthy of being tried. Although Mr. Greener may fancy he has reason to complain of a plan of his own having been laid on the shelf, he surely is not so illiberal as to object to the proposal of a brother inventor being considered.

Mr. Greener's remarks on the new rifle may, for aught I know, be very just: but whilst he finds fault with both the

old and the new rifle, he does not tell us which description of rifle is better; now it so happens that I lately met in company a commanding officer of a rifle corps, and had a conversation with him on the subject of the new arm, the opinion he expressed of its superiority over the old rifle was in conformity to that Mr. Greener quotes from Dr. Ure, whom he designates as the "unpractical man" (he said that the men could do more with the present rifle at 250 yards than with the old one at 150). The difference only is, that in the case I have mentioned the opinion came from a *practical* man. I quite agree with Mr. Greener in thinking that "national weapons should be the most perfect that can be produced;" and if he can produce a better arm than the rifle now issued to the rifle regiments, I hope it will be adopted: and moreover, if the sole merit of the present rifle consists in its novelty, I hope those who introduce it will meet the reprobation they so justly deserve for their most inconsiderate proceedings. That rifles are weapons of doubtful excellence I deny: in the hands of men who thoroughly understand their use they are most efficient and most formidable; that the men entrusted with them should be selected with the greatest care I have already stated to be my opinion.

Never having had an opportunity of seeing the carbines now sent to the Cavalry used on horseback, I am not able to say how far the objections to which Mr. Greener says they are liable are correctly stated; but I must, as a practical man, beg to express some doubt. These carbines are, I understand, of the same calibre as the musket—that is, they carry an ounce ball. Now, unless the charge of powder is excessive (and that, from the statement of the charges given in your paper very lately, it does not appear to be), I see no more reason why this arm should recoil violently, than my fowling-piece, with an ounce and a quarter of shot. As to "a carbine of half the weight being made that will project a ball three times the distance," I can hardly fancy Mr. Greener was serious when he wrote this sentence. When I see an arm that will do this, I shall believe it, but until I do see such an arm, Mr. Greener must pardon my incredulity. I have some recollection of having seen a very light carbine that was supplied to our Light Cavalry during the late war, and of which the person who introduced it spoke as highly, and no doubt thought as highly, as Mr. Greener does of his. The arm I mention was, I understand, on service, found totally inefficient.

DETONATOR.

January 2, 1842.

TO THE EDITOR OF THE NAVAL AND MILITARY GAZETTE.

SIR,—It is pleasing to see the increasing interest that is being taken in the attempt to improve the construction of the musket. I can assure you my wish is, that by discussion a correct conclusion may be arrived at, both in regard to the best form of *weapon,* the most correct weight of projectile, and the means of carrying on an offensive warfare, at distances where our enemies would find it useless to attempt a return of the compliment. This, sir, is only to be accomplished by the British military fire-arms being made the best and most perfect in the world: we can do it, and I don't see any reason why we should not. All authorities will agree that the legitimate intention of small fire-arms is to carry a projectile to the utmost horizontal range that can be obtained as to size or weight of projectile; it must be admitted, that the only intention is to kill or wound man or horse within a given distance. It is quite true a musket-ball cannot accomplish greater results; and hence what cause calls for heavier balls? what need requires a waste of gunpowder and an unnecessary expenditure of lead? for both these materials are directly wasted, while the waste is attended by other evils, a violent recoil and a diminished range. However, I shall briefly answer your remarks, and those of your respected correspondent A. C., *seriatim.* "The high authorities in our service who approve of the present ball" as the best may err; nor should I put much faith in the French military writers, who ascribe to the "British fire extraordinary efficiency;" for it is notorious that the celebrated Frenchman, Mons. Dupin, praises the defects which exist in our musket as the greatest benefit—so little do many learned men in reality know of the true principles of gunnery. I have been an attentive observer of military ball-practice for fifteen years, and I have little hesitation in saying that it requires near 45° elevation to enable one of our old muskets to project a ball 500 yards. It is equally well known that one-fourth of this elevation will with better guns give 1000 yards range. Then, admitting this fact, where does the inefficiency exist? I shall again repeat, the weight of our balls and the windage combined produce nearly the whole result—I say nearly, for a proportion is caused by the plain instead of the conical cupped breech. The excessive weight of ball requires an excess of explosive matter to give it a high velocity! the quantity of the explosion induces a recoil; recoil, a motion in the piece, and thus a corresponding inaccuracy in the flight of

the projectile; for it is an undisputed law in motion, that action and reaction are equal: thus the same amount of force is expended in recoiling the gun as in expelling the ball. The difference is as 12lbs. is to 1oz., or more properly to more than 1½oz., as the bore is 11. A reduction of size in the diameter of the bore would reduce the space of internal surface; and you might thus obtain during the explosion a more combined, concentrated, and powerful expelling medium, and this too with a diminished quantity of explosive matter. A much greater velocity can be given to a musket-ball than to a 6lb. shot; and the former ranges in proportion much farther; and this entirely arising from the expelling power being more economically concentrated, and consequently giving to the projectile a greater velocity and a more horizontal range. A ball 16 to the pound requires 6 drams of powder to project it to an equal distance with an eighteen, and a charge of 4 drams only. The ratio of windage existing is of that injurious tendency as to produce all the discrepancies existing between "a carbine one-half the weight of the whole carbine;" for it is indisputable that a carbine 4lbs. weight, carrying a ball 18 to the pound, and no windage, will project a ball "treble" the distance that a carbine 8lbs. weight musket-bore, with the present ratio of windage can possibly do. This is clearly proved, for the smaller ball receives three times the velocity of the larger.

In reality, Sir, I do not forget "that the heavier projectile always flies to the greatest distance, provided the quantity of powder is equal in proportion, and is fired from a gun in which the windage is not greater than in our present fire-arms." For here you, too, err, as every increase of powder above 3½ drams gives no increase of velocity proportionate, and the fact is proved by our Government reducing the charge from 6 drams to 4 drams: they attribute this to the percussion, but such is not the fact. I have tried muskets with graduated charges from 2 to 10 drams, and I find no increase of velocity proportionate after the charge has reached the above quantity; and here lies the evil I complain of; this arises from the highly expansive nature of the explosive fluid escaping past the ball, by the *windage* (and this before the ball has attained any velocity) and then expanding in front while yet in the tube, causing the ball to travel, as it were, amidst the *fluid*, which necessarily rules the medium of velocity. Here is the sole cause of the contemptible ranges of musketry with great windage. This, sir, is no theory, but found and deduced from actual experiment: the same defects exist in the largest artillery; for they, too, can obtain only a *certain* velocity; in

contradistinction, balls fired from barrels without any *unnecessary* windage, keep increasing in velocity with every increase of charge, even up to the 10 drams; and in experimenting, I have given velocity to an 18-ball, to make it equal in result to the pressure of 45,000lbs.; but the 10 drams fired in the musket, never gives a result greater than one-third of the above.

Then, again, you say, "How is the man to load in action, after the first six rounds, when his piece gets a little foul?" Quite easy, even to 100 rounds; all cartridges should be made of flannel, and the part inclosing the ball thicker than the other portion, if possible; the flannel, or felt, round the ball must be slightly greased; and, in this state, the tighter the cartridge fits the better; for thus it would remove the deposit every time, both in ramming down, and when driven out by the explosion. By observing this arrangement, 200 rounds may be fired without cleaning; while it is impossible to fire half that number from a barrel where windage exists; for all ball-shooters know well that where a ball fitting slack is used, the gun is sooner foul than under the opposite circumstances; and reason shows it must be so, for as an unctuous deposit is inseparable from the explosion of gunpowder, it is clear that if no means are taken to remove this deposit, it will soon so accumulate as to render the gun useless; then here appears the necessity for a portion being removed by every explosion: this a moderately tight ball does every discharge.

The excellent remarks of A. C. are deserving of the utmost attention; and I particularly agree with him in the necessity of joining theory with practice. I am also aware, that the resisting medium, in all cases, acts upon balls with extreme velocity, more so than with moderate; that all velocities, greater than 1300 feet per second, must cause a vacuum immediately behind the ball; yet I cannot perceive how this must induce a falling from the horizontal, for it will not be denied that greater velocity gives greater horizontal ranges: and the reverse requires an increased elevation to counteract the gravity. In experimenting in situations subject to the wind blowing direct across, the ball takes a curved direction with the current; and this the more, the higher the velocity; and thence I would argue, that instead of the vacuum inducing or aiding the gravity, it will have the contrary tendency; as it is a well-known fact, that the nearer the earth, the more dense the atmosphere; consequently, an inclination to rise into the lighter medium; or, at any event, counteracting the gravity

must be created even as the action of the air in a current upon the ball alters its direction.

"The proposal of Mr. Greener to introduce a smaller ball and a higher velocity, with the view of a more horizontal flight, should be received with caution; for the mere weight of the musket should not be reduced, unless it can be done without in any way injuring the power of the weapon." I have already clearly shown, that this can be done without injury to the arm, but truly improving it; and the method of argument pursued by A. C., and by others, is by no means lucid; nothing is advanced but doubting, all in doubt. It is difficult to convince in these cases; for the old proverb may be applied—"Convince a man against his will," &c. I would willingly manufacture a musket on the principles I have laid down, did the most distant prospect of being repaid appear: but really, sir, I have spent on the Board of Ordnance so much money already in producing them plans, that I cannot afford to do it again. But I unhesitatingly assert, I can produce a musket and cartridge complete, with which any soldier shall load as quick, and make better practice at double the distance, than he can do with the present unsightly, useless combination of wood, brass, and iron.

I am, sir, &c.

WILLIAM GREENER.

Pilgrim-street, Newcastle, Feb. 2, 1842.

TO THE EDITOR OF THE NAVAL AND MILITARY GAZETTE.

SIR,—I regret I have not that lucid mode of clearly showing my meaning that others have, yet I try to divest my language of any ambiguity; and a mind devoid of prejudice would easily perceive that the whole of my arguments tend to this point,—"That a much higher velocity can be given to a ball twenty to the pound than to a ball fifteen ditto, for the former requires a less quantity of explosive matter in proportion. The charge requisite to give an equal velocity to the larger ball, must be so great as inevitably to cause an amount of recoil dangerous to the user, and destructive of the accuracy of the range. I shall not enlarge upon your observations more than remark—whatever "your learning on projectiles may teach you," you still lose sight of one essential point, namely, that it is only where *velocities are equal* that the heavier projectile ranges the furthest. Therefore, if you do adhere to the present weight of ball with less windage, still you cannot *conveniently* obtain the same horizontal range.

In answer to your concluding paragraph, I beg to inform you, that I was the first to lay a foundation for firing cannon by

percussion; and you will find, at p. 301 of my last work, some further account of another plan already alluded to. My principal complaint against the Board of Ordnance is, that "uninfluential individuals are generally treated very cavalierly."

The long letter by Dr. Metford (*N. & M. G.*, 5th February), does not in any way alter the data I have laid down, nor give us further insight into the science of projectiles, but in truth establishes the accuracy of all I have advanced. One especial point, indeed, he loses all sight of (and I am afraid other readers of these letters may likewise do the same), namely, that my opposition to the rifle is only "as a military weapon." I do not doubt that the Doctor may have attained considerable proficiency in rifle shooting—and I myself have also practised the amusement not a little—the result of which practice, fully convinces me of the utter inefficiency of the rifle as a military accoutrement; for it is strictly out of the question to expect accuracy, velocity, and range combined, from a rifle. These you may attain from a plain bored barrel,—for the greater the velocity the greater the accuracy of the ball's flight. The tube opposes less friction, but gives direction; and I am satisfied that gravity has less effect on the ball with high velocity than with the reverse. One fact we are all aware of, namely, that in the one case the ball is under its influence only half the period of time. Now high velocity in a rifle ball is incompatible. Let us recollect that the spiral of even the Doctor's barrel requires the ball to turn once in every three feet: thus, with a velocity of 3000 feet per second, a spinning motion equal in proportion to 1000 times is created. Now to imagine the friction grating upon the air, is enough to clearly convince any party that it must be at the expense of the force given, and tend to shorten the range by expending the impetus. The Doctor alludes to my assertion of a plain barrel excelling the rifle at 800 yards. Experiment would soon convince him of the truth of this; and he need only remember that the cylindrical ball is less than one-half the time in travelling the distance, and has to travel less, from requiring less elevation. Few indeed have ever expended either time or money in perfecting plain-barrelled ball guns, and such as have been made are *imperfect* muskets, and are no criterion of the truth of my theory. Scientific men are as apt as others to be led astray by the glaring appearance of science, where in reality it scarcely exists. The assertion that "the two grooved rifle is an abortion of science," will become the more apparent the more it is investigated; nor do I think much is gained by the four grooved barrel, for it has the same defects though in a less ratio. One defect, however, I think the Doctor does not perceive. The

plan is a *double-belted* ball crossing each other at what, for illustration, I may term the poles of the sphere. Now the ball must be inserted into the barrel at the *equator;* for if the poles change in the slightest degree from the perpendicular, the belts contracting in that direction will not fit the grooves : a very slight uneven friction will cause the balls to do this either in running down or in being driven out. This must both increase the friction and alter the shape of the ball. A great improvement may be effected by using plugs of a cylindrical shape, having the upper end round and the part next the powder flat or concave ; this would enable it to be used with regular results, and give to this shaped bullet the greatest spinning motion beneficial. If rifles are of any use, it would be by constructing them to admit of high velocity; and this can be done with a proportionate spiral, and the adoption of the plug similar to the above. Because in this case you may load with the greatest facility; and by the expansion of the ball it would fit itself into the grooves of the rifle, and thus receive the modicum of spiral motion required.

I have adopted these plugs or bullets to double guns for use in India, with the greatest success, and I am prepared to contest the plan with any yet produced for precision and range. A late writer on Military Fire-arms, Mons. Schlimberg, states "the velocity of the French musket-ball is 1409 feet per second, while the English is but 1250. French windage 0·6 of a line, English 0·9. By the above charge and windage, the French ball in quitting the barrel receives more oblique and numerous impulsions, a greater and more variable angle of departure." I cannot perceive the logic of this argument, especially when we see the velocity is 150 feet per second greater in the French than the English ball; as a matter of certainty, the higher velocity will be less liable to "various impulsions." For it is an admitted truth by all scientific men, that where the greatest disparity of size exists between the diameter of the tube and that of the ball, a zigzag flight or motion in the ball must be created in the tube, as the force of the propelling fluid preponderates on one side or the other; and consequently a ball projected from a tube with an excessive windage and at a low velocity, must naturally receive the greatest variety of "impulsions," and be most influenced in its range by these motions.

The action of balls in brass guns is a decisive proof of this: for with them the zigzag motion of the ball changes the bore of the piece from a circle to an ellipse, and that too, in less than 800 rounds. Monsieur would have been right had he reversed the case; for few will be met with at the present day to contend that velocity does not beget both accuracy and range. An il-

lustration of the argument may be found in the experiments with Mr. Monk's gun at Woolwich; for here, by a scientific distribution of the metal in casting the gun, a reduction of the windage, and the adoption of compound shot, a range of $3\frac{1}{4}$ miles has been obtained. The velocity of the ball during the first second, was equal to 2,400 feet (just double that of a musket), and the recoil considerably less than that experienced in guns possessing half the power of projecting. "Moreover, these differences of charge and windage cause the bullets to lose their spherical form, and thus not only induce uncertainty in the ranges, but are also the origin of lateral directions." As he is arguing in favour of the low velocity, he to a certainty means that the higher produces the change in shape. I am quite satisfied from this, that he strictly possesses no knowledge of the subject whatever, or he could not be ignorant that a leaden ball striking the sides of a tube with a velocity 1409 feet per second, and at the slight angle that a windage of 0·6 of a line permits, cannot be mis-shaped, for the higher the velocity with which dense, uncompressible, non-conducting bodies of metal are struck or come in collision with other compressible metals, the less derangement takes place in the shape of the lead. A leaden ball striking a bed of sand at a slight angle, changes that angle, and on examination is uninjured in shape; but an iron ball projected—at right angles—against a body of lead, is splintered into many pieces, and the injury the lead has received is scarcely perceptible; and the higher the velocity of the ball, the more certain is this effect. We here perceive that ramparts could be constructed, which it would be perfectly impossible to breach with the best artillery in the world. He again says, "And admitting that the velocity of the French bullet exceeds the English by 150 feet per second, nevertheless the latter, although larger, offering to the air resistance relatively less, would yet have a range and precision of fire greater than the first." Here, again, he most clearly shows that he is unacquainted with the simplest rules relating to projectile force, otherwise he must have known that it is only *where the initial velocities are equal, that an increased weight counteracts the opposing medium, and ranges further.* Can it possibly be of any advantage, in a case where the velocity does not reach that of sound (for the English musket-ball does not ?)

In the instance of the large gun just mentioned, weight tells, for an iron ball the same diameter does not range so far by some hundred yards, though projected with the same initial velocity, as the compound shot does. The obsolete rule may apply to artillery and iron-balls, but not to leaden ones, when the density and weight is in proportion to the circumference.

An ounce ball, and a half-ounce ball, projected with identically the same velocity and elevation, range as near as possible alike in distance; and the French, having an extra velocity, will to a certainty, range much further than the English at the same elevation.

Again he says, "Moreover the reduced charge of the English causes the barrel to become less foul;—the recoil also being much less, the soldier has no hesitation in firing." Both use the common plug-breach. Now the recoil is strictly caused by the opposing surface; for the merit of the case is the difference between the space existing in a circle of six-eighths, and one less than five-eighths in diameter, or the resistance of a ball of eleven to the pound, and one of twenty, ditto. Thus, instead of the recoil of the French musket being greater than the English, any school-boy will prove to Mons. Schlimberg it cannot be, and is not more than one-half.

Again, he says—"Accuracy of fire increases, it is true, with the velocity, if, according to the data of mathematicians, the ball quits the barrel parallel to the axis of the piece, and if also the ball is not altered in its *form by the flight through the barrel;* but as the nature of circumstances does not always conform to the calculations of mathematicians, in this instance the contrary takes place." The ball cannot quit the barrel parallel to the axis if any windage exists, or no means be taken by covering the ball with wadding to neutralize the windage; but if this be done, and the ball accurately fits the barrel, it will and must quit the bore parallel to the axis, if the impetus is sufficient. The writer has been quoted as an authority to prove the English musket an excellent weapon, while it is quite clear he does not understand the data of mathematicians—he is not an experimenter—he has no theory of his own.

I am glad to be enabled to introduce the testimony of evidently an experienced soldier, who in describing the Austrian Light Infantry and their arms, in the *United Service Magazine* of February, has the following remarks:—

"It is a great mistake, and one into which many people fall, to believe that the 'Jager Corps' are armed exclusively with rifle guns, or 'Staten,' as the Germans call them. All the non-commissioned officers, and but one-third of the privates, are armed with this weapon, which is so efficient and valuable *when of very superior quality,* and placed in very efficient hands; but we will add, then only."

Precisely so; and it will come to this conclusion eventually, that when the musket is of *very superior quality* also, the value will not be recognisable.

But again. "It has been found matter of experience that

amongst the Tyrolese and Bohemians, who are all, even as peasants, celebrated for their superior shooting, not more than one-third of those men can use the rifle with greater effect than a *good carbine*."

It is a difficult matter to get rid of old prejudices, and he that wishes to accomplish this must do it gradually if he hopes to succeed; and I may not be doing it prudently, by again asserting that the superiority of a rifle is entirely " in the imagination." Let but the same skill and care be displayed in the manufacture of muskets, and they too would become " valuable weapons" in efficient hands. But while gunnery remains as it is there must be rifles, and there must be muskets; and for want of investigation improvement will lag in its march.

Further. " Any one who has practised rifle shooting will not think this strange. Such persons will understand the necessity of a steady hand, capability of judging distances, the influence of the atmosphere, the sun, the wind, the nature of the ground over which the ball passes, all have on its flight." Exactly so. A rifle is only useful when fired with the charges of powder so small as not to disturb the equilibrium of the rifle, at such an elevation too as requires "judges of distance." Why? Because the ball is only pitched to its range. And I know not how many more requisites are necessary for no earthly advantage.

In the time of Robins, musket-balls could be projected quite as far as at the present day. In the days of Hutton, it has been calculated that gunpowder became so much improved as to be double the strength, *i. e.* velocity. The advantage of this would be to give increased range, and at half the elevation adopted by Robins. But the rifles of the present day, retrograde to the time of Robins; for by artificial friction in the grooving of the barrel, and the charge of powder used, the same elevation is required, and no greater range obtained. What would that philosopher say of us, could he return and see the little advantage we have taken of the excellent foundation he laid for our advancement in the science? In reality this is a fact, that we are little if any progressed in the science or knowledge of gunnery and gunpowder than when he left us.

Another quotation. " The Croatians Light Austrian troops were deprived of a large portion of their rifles, in consequence of its being found that their efficiency was impaired by a too great number of rifles for the proportion of men found capable of using them skilfully. Let me remark, that notwithstanding this, they afterwards beat the Tyrolesė in shooting."

This is to be admired and noticed for two reasons. It proves the advantage in rifles to be doubtful; and it also shows that

the Austrians have much improved their carbines. To me it is quite conclusive, and will be so to all the unprejudiced. Therefore I again hope our government will see the necessity of some extensive improvements, to be in keeping with the *élite* of Europe. I have been favoured with several plans from both branches of the service, and by combining them, I conceive that a very simple and very durable double-barrelled musket might be constructed, and not to exceed much in cost the present single one. Captain Bentham advocates their adoption, and with excellent reasoning, for the light infantry. Lieutenant Okes, of the Navy, suggests the adoption of iron stocks. I have been planning a double musket which shall not exceed $10\frac{1}{2}$ lbs. in weight, to have hollow iron stocks, covered with some material to lessen the coldness to the feel, and also to protect from rust. I can easily by the combination, get a perfectly centrical fire—a very simple weapon, and without a many disadvantages existing as at present. I throw out the suggestion, and will be glad to hear opinions upon it.

WILLIAM GREENER.

To General Sir George Murray, G.C.B., and G.C.H., Master General of the Board of Ordnance.

Sir,—Small apology will suffice to you when you perceive the only reason which induces me thus publicly to address you, springs solely from a disinterested wish for the welfare of the service, of which permit me to say you are a distinguished ornament. I have laboured, Sir, in this service for a length of time, with what success and what encouragement you will, after perusing this letter, be enabled to form some judgment. That I have laboured without reward, or even the hopes of any, save in self-satisfaction, all parties will, I think, admit. It will be in your recollection, Sir, that I have repeatedly called the attention of the Board and the public generally to the inefficient state of the small arms of the British soldiery; you will also be aware that in consequence of these remarks, I was induced, at the solicitation of a portion of the officers of the British army, to offer to construct for the Ordnance model single and double muskets, "on my own principles and plans;" you will also be aware that from an order of the Board, dated 16th April, 1842, I undertook to construct such muskets; they agreeing to defray the actual amount of cost, and *no more*. On the 18th June last, these muskets were delivered to the Board, and by them referred to the Select Committee at Woolwich; and Sir, it is from the decision and conduct of this Committee that

I appeal to you. I shall, before proceeding further, state, that my acknowledgements are due to every member of the Board in Pall Mall, whom I had the honour of meeting, for the greatest urbanity, kindness, and civility; they seemed to rightly estimate my intentions, and to give me credit (however much we differed on principles) for an enthusiastic devotion to improve the structure of the musket. I wish I could have said so much for the Select Committee.

At the time appointed, 22nd June, I waited upon this Committee in the arsenal at Woolwich, and in endeavouring to detail the strange and unaccountable discussion that succeeded, I shall avoid the slightest exaggeration; I shall not colour the picture. I had intimated to me at the Board that I might calculate upon the muskets being subjected to the most searching and decisive proofs that could be devised or thought essential. At this intimation I was delighted, and I thus went as a man would do who is certain of victory; for I felt conscious that experiment would satisfy even the most prejudiced, that no description of musket yet manufactured could in any way cope with the muskets I had the honour of submitting to them, "*in either accuracy or range.*" Judge then my astonishment and consternation (after a few preliminary remarks had taken place) to receive the interrogatory "How came you to manufacture a musket that will not admit of the present size of *ball?*" I replied, "Gentlemen, if you will refer to my offer to the Board, you will find that I offered to construct a musket *on my own principles*, and knowing for a certainty that the present large size of ball is a defect, I have produced you one calculated to be more effective, to be the less burthensome to the soldier, and of less cost to the country; and for this purpose, Gentlemen, I have come to London: I have attended upon you here, to the end that the requisite trials may be gone through, and the superiority of the *old* or the *new* musket satisfactorily ascertained. With this intent I have made these muskets; and feeling that they are in every point superior to the present construction, I fearlessly appeal to your candour, to your honour, to your love of fair play, to grant me the opportunity of satisfying you that I am right, or if wrong, it will for ever satisfy the public that I have presumed to the knowledge I possess not." To this moderate request I met a positive refusal; and the only argument worthy of the name they vouchsafed to give me was this: "I recollect," said the president, "some years ago, when the subject of reducing the weight of the musket was on the tapis, that his Grace the Duke of Wellington remarked, 'Well, Gentlemen, I can only say, that any one who went with me through the Peninsular War, and saw the superior effect of the British

musket over that of the French, would never advocate any alteration.' " The absurdity of this argument must be as glaring as the light of a harvest moon. I very much doubt whether his Grace would like to meet the French again with nothing in the hands of his Infantry but "old English muskets." Can any unprejudiced man believe for one moment that other nations have not improved their musketry? That a quarter of a century has been allowed to elapse without any progressive steps in improvement—the idea is ridiculous. Had we conquered the world combined with our late inefficient arms, would that justify us in retaining them? Not at all. Rather ought we to hold the power, by being prepared under all circumstances to add to superior prowess superior arms. The remainder of the interview was expended in vainly endeavouring to convince the Committee that they had taken up a false position—that they entertained erroneous views on the subject of gunnery. But prejudice had taken root too firmly in their minds to be dislodged *by small arms*; and I was eventually obliged to abandon the contest in disgust. They seemed (at least those members who took part in the discussion) to think I had *presumed* in interfering with the subject, that to them alone appertains all the knowledge on the question; and from their extensive connexions with gunnery, they as a matter of course, must only understand it. I wish I could compliment them upon this point. I feel it my duty, Sir, to submit to you, whether or not artillery officers are sufficient judges on matters connected with small arms; for recollect, Sir, they invariably believe Infantry to be but an adjunct to the Artillery. They forget and reverse their position, and sink all but the plural "WE." I speak but the sentiments of a great portion of the army—the sentiment I have heard from the lips of every grade of officers, from the subaltern to the general. I will, Sir, give you an instance of the estimation an artilleryman holds a musket ball in. "What, Sir," says Colonel Dundas, "do you mean to say that you can give a greater velocity to a musket-ball than to a 68 lb. shot?" Now, I submit to you, Sir, that in this point consists the very utility of small fire-arms. From the concentrated and economical distribution of force in small fire-arms, you can project a small ball of lead further in a horizontal direction from a shoulder-gun, than in any piece of artillery constructed. I will give you an instance. Half a degree of elevation will suffice in the small arm to enable it to range 600 yards: it takes three times that amount with any piece of ordnance in the service. Then here is the clearest proof of velocity: it travels the distance in little more than half the period of time; it describes but one-third the parabola. So much

for an artilleryman's knowledge of comparative velocity. I will give Colonel Dundas a homely and a *feeling* illustration of this fact. You will, Sir, recollect, a few years ago, Mr. Monk planned and perfected a gun which has since been, and is now, the wonder of the world, having the greatest range ever yet attained; a report states that the Colonel was ambitious of excelling this piece of perfection; and, in consequence, he has had a gun constructed weighing seven tons, and calculated, as he thought, to throw a ball a greater range than is obtained by Mr. Monk's; yet, although he added 2¼ tons in weight to the gun, and instead of a ball 55 lbs. he adopted 68 lbs., for a charge of 17 lbs. of powder he took 23 lbs.—yet, in spite of this additional weight of explosive force and *additional momentum,* he could not accomplish the same range by nearly 1000 yards. You will perceive here, that it is a fallacy to say, "heavier balls range the farthest." This only takes place where the *initial velocity* is the same. Colonel Dundas cannot give with his gun the same impetus to the 68 lb. shot Mr. Monk's gun gives to the 55 lb.; and hence the disparity. Here, Sir, allow me to say, thus precisely am I situated—I can give a greater velocity to a ball 19 to the lb., than is given by the present musket to the ball 15 to the lb.; and hence, Sir, the superiority of the construction. I may diverge and inform you that several trials took place previously to my delivering the guns in question to the Board, and one of them in presence of several officers of distinction, who will confirm my statement, viz., that the new musket shot much better—to use their own words, "infinitely better;" that the range was much greater; and, lastly, that private soldiers put into the target double the number of shots with one than the other. The single musket on water (with trifling elevation, in fact nearly point-blank) ranged above 1200 yards; the double, the astonishing distance of 1380 yards. The ball of the single is 17, the double 19 to the lb.; charge 4 drams of powder. It is now an idle argument to contend that balls are most destructive when heaviest; for it is clearly evident that velocity is force, and that velocity gives power and penetration which weight can never give wanting the necessary impetus. How is it, Sir, the Affghans cut off our troops at distances where our muskets were useless? They say, "From the length of their pieces:" granted. But the length of their pieces only gives them the means of giving to the projectile "a greater velocity;" the length of the barrel is only an adjunct in confining the explosive matter until the projectile has received the maximum of force. It was stated by the press a few days ago, that fears were entertained that a part of our troops had been cut off in the interior of Africa by a party

of emigrant "boers," who are armed with guns termed "long roers," and which range one-third further than our English muskets. Since confirmed. These facts accumulate too fast, Sir; "every savage can beat an Englishman." Why should it be so? These guns are manufactured, I believe, in England; yet English soldiers are armed with muskets that will not range so far by one-third; this comes of allowing these matters to be decided by *Artillerymen*. Pray, Sir, who ever heard of any great improvement being effected in gunnery by the class? Civilians, I believe, have effected nine-tenths of what has been done (see Robins, Hutton, Dr. Gregory, and lastly, Monk.) I have no wish to throw any slur on the body, quite the reverse; but when in the face of facts they unceremoniously oppose every improvement which emanates not from themselves, I contend I am justified in throwing a few shells into their entrenchments. This want of knowledge of gunnery on the part of this irresponsible body will, I fear, lead to results which will hereafter be deplored. My former letters exposed the mechanical defects in the construction of the present musket locks, and it is but fair to acquit this Select Committee of a portion of blame which may attach to them. For the small-arm inspector, Mr. Lovell, in discussing the advantages and defects of the swivel and hook tumbler, unhesitatingly asserted *he would not have the swivel-locks*, and why?—"because the workmen could not fit the swivel true:" it is really painful to listen to such nonsense. But mark, Sir, if ever our infantry are engaged in a lengthened contest where no time can be spared to take off the locks to oil them, the majority will become useless in the hands of the men, for there is a principle of friction in the hook main-spring, which, in hot countries especially, will render the arm useless in 60 rounds. Now, Sir, the additional cost of a hook and swivel-lock is *one shilling and sixpence*.—Another subject, Sir, and I have done. The two-grooved rifle obtained during the discussion a portion of our attention: this, Sir, is a plan of Mr. Lovell's, who has profited by the example of the Committee, and become also an inventor. How far his inventions will benefit his country, time will show; but in as far as the two-grooved rifle goes, short time will suffice to show its absolute uselessness and inutility. This plan I have before termed an *abortion of science*. It has converted the rifle corps into *shell brigades*, for in truth this is the practice. Judge, Sir, and let any partisan of the system contradict it if he can, they have no point-blank range whatever—no, not even at 30 yards, and it actually requires 2½ degrees of elevation to project this rifle ball 200 yards. In this distance, the ball describes a parabolic curve, of which the highest altitude of the arch is many

feet above the base. Now, Sir, is this not shell practice to all intents and purposes? then, believe me, this is the greatest improvement—*i. e.*, alteration—ever effected by the Select Committee and Mr. Lovell combined. I was challenged to a competition against this arm at 200 yards, which I offered to accept if they would increase the distance to 600, but this it was convenient to decline. But, however, Sir, I again repeat my offer —I will, for a moderate amount, contend at 500, 600, and even 800 yards, with my present plan of musket, against any *military arm* at present in use, under precisely the same arrangement being observed in both arms. The generality of soldiers can never obtain with these rifles any degree of perfection or accuracy; for, to use them with any efficiency, the parties must have an immensity of practice, must be excellent judges of distance—for the want of horizontal range necessitates a system of pitch to a given point. These arms ought to be abandoned —they will never *add* to our glory—for time will show these *shell brigades* to be very injudiciously armed—the most ineffective in the service. The same elevation required by this rifle to range 100 yards, will suffice with my musket for 400 yards. Now, Sir, consider which is most likely to be useful: it is a waste of time to say or contend that there can be any equality for military purposes, and to you, Sir, I appeal for justice: all I ask is a fair trial. It does not follow that the Board are necessitated to adopt a ball of less weight, but the time was when the British Government lent its aid to individuals in perfecting the knowledge of gunnery. I see no reason why it should not be so now. Expense, Sir, cannot be an excuse, for 10s. would have defrayed the whole expense, yet, Sir, the Committee made this the stumbling-block; in proof of which I quote a paragraph inserted by one of the Committee the day following (in the *Times*) my interview with them at Woolwich; it speaks for itself:—"It is but just to observe, from what was witnessed to-day, that the members of the Select Committee spare no personal exertion in making experiments for the benefit of the Service; and that every invention submitted to them, obtains a fair trial to ascertain its real value; but being practically acquainted with that department, they at once decline encouraging unnecessary expense, where there is no probability of its being attended with a beneficial result." Now, Sir, it is a fact pretty well admitted, that no invention submitted to them meets a fair trial. I ask you, Sir, for a trial—I ask you, Sir, to appoint impartial and competent judges, but neither bulk nor sample of the Select Committee shall ever sit in judgment on a plan of mine, so long as I can prevent it. I ask, Sir, the most searching investigation into the merits of the system; and the

more scientific and learned the judges, the more I should appreciate them. I feel certain (I reluctantly give utterance to it) the merits of the muskets were not appreciated because I had presumed to denominate the party *unpractical* men. The head of the small-arm department is no doubt an excellent *viewer;* but whatever may be his qualifications on this point, his knowledge on the science of gunnery is upon the inverse ratio, and so long as this system is allowed to reign uncontrolled, so long may the British army; depend upon it, no effectual improvement will, nor can possibly be effected in the construction of the musket. It will be in your recollection, Sir, that I, in December last, prognosticated that very few years would render the whole of the altered muskets the troops had been furnished with unserviceable and useless; of the truth of this prophecy, you will now be aware, I did not anticipate so short a period would verify my assertions; but when scores of muskets become disabled every succeeding ball-practice, and these, too, in geometrical progression—the whole total of the times they have been fired does not reach 100 rounds—what, Sir, would have been the state after the wear and tear of an active campaign? Can these arms be fit for use? I say, decidedly not. I shall only glance at the immense quantity of bayonets returned to the small-arms departments alone from this one regiment, worn out, I need not tell you from what cause. Can I err, when I say all this arises from a want of practical men? Verily, it does, Sir,—I have, &c.

WILLIAM GREENER.

Newcastle-upon-Tyne, Sept. 20, 1842.

THE NEW FRENCH RIFLE CORPS.

The formation of a rifle corps in France under the title of Chasseurs d'Afrique, at present called Chasseurs d'Orleans, was viewed at first with jealousy, because that body was regarded in the light of Garde Royale. Whatever the views of Government in respect of it, the training of the corps has proceeded with much activity. The soldiers of it are now said to equal the best in Europe. "Of their pretension to the rank of Riflemen," says one of our Paris letters, "your military readers at least will be able to judge from the following account of their practice, published in the *Journal des Débats*:—

"An experiment was made at Vincennes on Wednesday, the 19th inst., in the presence of the Duke de Montpensier and of General Rostolan, as to the relative merits of the common

musket used by the Infantry of the line and the improved carbine of the Chasseurs. The musket was fired by some of the best marksmen of the 68th regiment of the line, but their address was impotent against the great superiority of the carbine. In a series of experiments, which lasted six hours, the men of the 68th placed seven balls out of 200 shots in the target at 400 yards' distance, whilst the Chasseurs placed ten times the number of balls in the same number of shots. The Chasseurs afterwards placed 33 balls out of 200 in the target at 500 yards' distance, and 25 at 600 yards. When it is considered that 500 yards is the usual distance at which field-pieces are placed from the object to be reached, and 600 yards that of a 24-pounder, it cannot be denied but that a complete revolution is about to be made in Infantry muskets in consequence of the adoption of M. Desvigne's invention."

"A month or five weeks since," continues our correspondent, "I went to Vincennes to see the new works in progress for completing the fortress. I am not qualified to decide upon their claim to perfection—for they will, it is said, be perfect,—but I was astonished by their extent.

"I returned to town on foot through the wood, and found a battalion of the new rifle corps at exercise in the alleys and thickets. They were occupied in a way quite new to me, who am, I confess, unlearned in these matters. If it be new, a word or two respecting it may not be uninteresting to some classes of your readers.

"A soldier bearing a target ran ahead from his section (for the body was divided into many) to a distance of (it would seem) as many hundred yards as he pleased. Having planted it, his comrades of the section were then in rotation called up to the point from which he with the target had started, and asked the distance to it. Having replied, his guess was entered opposite to his name, and so on with the rest.

"Although this was evidently exercise, and with a view peculiarly applicable to the rifle service, and done too in the presence of an officer, it combined with it amusement, which the soldiers appeared to relish exceedingly. There was first a laugh at those who guessed widely, and then the fun of a race to take a new start; but I could perceive by the gravity with which the presiding sergeant inspected the entries that he entered warmly into the system of training for that branch of the army."

Times, October 28, 1844.

SMALL ARMS.

TO THE EDITOR OF THE TIMES.

SIR,—Now that the defences of the country are exciting some attention, a few remarks on personal weapons may be productive of some advantage to the community.

Since the year 1841, when you did me the honour to insert several of my letters on defensive implements, I have devoted considerable time and expense in pursuit of a thorough knowledge of the subject.

I have visited, and personally inspected, the manufactories and the practise in shooting of every state in Europe of any note, save Russia, and of the arms of that kingdom and America, I have duplicates and drawings. With these few introductory remarks, I may, I trust, without egotism, claim the merit of possessing a perfect acquaintance with the matter in question, alike important and engrossing at the present moment. It is beside my purpose to advert at length to the probability that our soldiers may be required for sterner duty than merely to

"Gild the gay parade and shine at home,"

but most assuredly the tocsin is sounding in more states than one.

The calm of peace has been fully employed lately in preparing weapons of deadly power, but more especially in France, who seems determined, if improvement, application, and assiduity, can change "the fortune of war" hereafter, she, at all events, will be ready.

I should rejoice much, indeed, were the parties who manage the small-arms department in this country equally well employed, but I much fear the declaration of an illustrious individual—(viz. "every one who fought with me in the Peninsular War, must be perfectly convinced of the superior effect of our arms over those of the French, and be no advocates for alteration,")—has produced baneful effects, and we may ultimately gather the fruits of such pernicious counsel.

Having witnessed the ball practice of the infantry of more than one nation, and having fully and fairly tested every sort of arm in the British army, I will now state the comparative merits of the French and English muskets. The French musket is a very handy well balanced weapon, some inches longer than ours and three pounds lighter: when the bayonet is fixed the soldier has at least five inches advantage for a thrust, but this is a

trifle when compared with the shooting qualities; the range, with a less charge of powder than we use, is between 1300 and 1400 yards—the usual practice is up to 800 yards: our musket will under no circumstance range more than 900. The advantage here is so evident as to require no comment. The French rifle is also a much more efficient weapon than ours; its weight is about ten pounds, the range quite up to 1400 yards; it is practised with at 1000 yards; and at that distance will strike a target of 30 square feet with 15 per cent. of the shots: at 800 yards the average is 32 per cent.; at 600 yards 54 per cent. Now, Sir, what is the fact in reference to our new rifle, every one costing the country between £5 and £6 each? The extreme range is 700 yards, and at 200 yards the hitting is not 20 per cent. I solemnly aver that this is not an exaggerated statement.

The public may reasonably inquire what is the comparative cost of the two countries arms. The French musket costs 34 francs; the rifle, 36 francs. The English musket £3, but when the vast unnecessary establishment is considered, cannot cost less than £4 10*s*. each: the cost of the rifle is already given. It may be asserted the French musket must be inferior to ours in workmanship. Such is not the case, but in truth better suited to the purpose intended, not so sightly, but for quality of barrel, superiority in the principle of the lock, durability, and strength, there is no comparison. These assertions will undoubtedly appear strange, "passing strange," but nevertheless, they are incontrovertible. That great blame is attributable somewhere cannot be denied, and in proof I shall only adduce one statement and thousands will re-echo it. There has been more money spent in this country in ridiculous scheming in bayonet springs and other speculative follies than would have purchased arms for five battalions of infantry. Now that weapons of warfare may possibly be required to an almost indefinite extent, some serious inquiry into the department which superintends their provision should be instituted. If a committee of competent and unprejudiced persons were appointed, I pledge myself that they would be so convinced of existing abuses that their continuance would be no longer possible.

In addition to the perfection of foreign arms, is the care bestowed in instructing the soldier in their use. At Vincennes is established a sort of normal school for teaching shooting to the whole army. In the spring of the year each regiment in the service sends a detachment of intelligent men who are taught the "true and practical principles" of gunnery at every distance, from the muzzle of the gun to 1000 paces, and practised in finding these distances under all circumstances; when perfect, they are

dispatched to teach the regiments. The consequence is—the French army are at this moment the best shots of any army in the world. What have we done in this matter? Nothing, absolutely nothing. There are no means of instruction used. The rifleman can shoot as well as an infantry man of the line, and *vice versa*. All this springs from overweening confidence,—vanity has produced many evils. The idea of perfection has precluded all national experiment, while on the other side of the picture, may be beheld this fact:—in 1844, Belgium carried through one experiment, at Antwerp, extending to 44,000 rounds to ascertain the best sized musket, and the trial included the rifle and musket of England. In conversing with an officer of high rank who was present, he remarked:—"You have" says he, "unquestionably, the worst musket in principle of any nation in Europe, and your rifle is the most unfit for a military weapon of any I ever saw." With these facts staring us in the face, will any thing be done? Will any steps be taken to avert the evil consequences that must ensue to our brave men if ever a war takes place? No, I cannot think such blindness can long exist, and I shall not hesitate to lift up a warning voice until some efficient reform in this important subject take place.

In conclusion, I will merely add one remark. You will probably recollect I recommended the adoption of a double musket by our Light Infantry, but the idea was not entertained; the French, however, always alive to the perfection of their armour, have adopted it in some of their chasseur regiments.

I am, Sir,
Your obedient servant,
WILLIAM GREENER.

Aston New Town, Birmingham,
December, 20, 1845.

WILLIAM GREENER,

GUN-MAKER

TO H. R. H. PRINCE ALBERT, THE DUKE OF CAMBRIDGE, &c.

ASTON NEW TOWN, BIRMINGHAM,

In returning thanks to the Sporting World for their distinguished support during many years, begs to intimate to them that he has now accomplished the long cherished wish of establishing his manufactory in Birmingham, the seat of the gun manufacture, where the facilities of producing a first rate gun are superior to any other locality in the world, for here he can reject imperfect materials and replace them while makers in other parts of the kingdom would be writing about the deficiency. Here he can exercise his own judgment on the goodness of material during the progress of production; here he can carry out any alteration or improvement in barrels or locks that may suggest itself; and here eventually will settle the whole manufacture for the kingdom. This is nearly accomplished now, for it would be idle to conceal the fact that a vast majority of what is sold in London, as London make, is made here. Here the best workmen are congregating and meet with the greatest encouragement. Under these circumstances he has judged it best to avail himself of the means offered of producing without "egotism" guns superior to anything yet produced by any maker whatever. This may be considered a wide assertion, but to prove he does not make it rashly he is prepared to test the fact by a competition with any maker whatever, barring none; to be decided by the following five points: 1st, safety,—the greatest difficulty in bursting; 2ndly, lightness; 3rdly, goodness of shooting,—strength and closeness combined with the least charges; 4thly, durability; 5thly, beauty and taste combined.

He considers it a crime of great magnitude that guns should burst, they never do so where proper metal is used; he will produce an ordinary weight of barrel which he will allow any

one to burst if they can ; in fact, he believes it to be the greatest difficulty to do so.

W. G. will undertake contracts for quantities of arms subject to private arrangement, such as military arms, shipping ditto, rifles or sealing guns, for foreign powers or private companies, provided in all cases the quality be sufficiently good to enable him to brand them with his name ; anything inferior he declines to make.

The prices of his guns are as under:—	£	s.	d.
Double rifles of very superior quality of taste and finish, case complete with every requisite	40	0	0
Double guns of very superior quality, with laminated steel barrels, &c., case and every requisite complete	35	0	0
Double rifle, second quality, same material but not so highly finished, case complete	30	0	0
Double gun, second quality, same material, but not so highly finished, case complete	25	0	0
Double rifle, excellent quality, stubs twist, no case	18	0	0
Double gun, excellent quality, stubs twist, no case	15	0	0
Double rifle, good	10	10	0
Double gun, good	8	10	0
Double rifle, no engraving &c.	8	0	0
Double gun, ditto.	6	0	0
Very best single rifles, superior style and finish, case complete	21	0	0
Second quality, case	16	16	0
Good quality, no case	10	10	0
Plain, ditto.	5	0	0
Sealing rifles	3	10	0
Very best single gun, case complete	16	16	0
Second quality, with case	12	12	0
Good quality....	7	0	0
Plain, ditto.	4	0	0
Sealing, or other guns in quantity	3	0	0
Musket percussion, swivel locks	2	0	0
Plain, ditto.	1	5	0

The above includes every size which can be fired from the shoulder.

Pistols, Cutlasses, Pikes, &c. supplied on the most moderate Terms.

Business done for cash on delivery only. Foreign Bills for orders payable in London, or reference for payment in any part of England.

J. BILLING, PRINTER, WOKING, SURREY.